# The Foundry Trade Journal

## AND PATTERN MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION

Vol. 20. NOVEMBER, 1918. No. 203.

PUBLISHED THE FIRST WEEK IN EACH MONTH

Subscription Terms: 7s. 6d. per annum, post free.

To place the "Journal" within the reach of working Moulders and Pattern-makers, the Proprietors will accept subscriptions, not less than three in number from one shop, at the reduced rate of 5s. per annum, such order to be countersigned by the superintendent or foreman.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

The Foundry Trade Journal,
165, Strand, London, W.C.

OWING TO THE REDUCTIONS IMPOSED BY THE GOVERNMENT ON PAPER SUPPLIES, THE PROPRIETORS ARE COMPELLED TO PUBLISH "THE FOUNDRY TRADE JOURNAL" ON A THIN PAPER DURING THE CONTINUANCE OF THE RESTRICTIONS.

BRITISH FOUNDRYMEN'S ASSOCIATION.

LIST OF SECRETARIES—

General Secretary: Alexander Hayes, 116, Rusthall Avenue, Bedford Park, London, W.4.

Manchester: J. Hogg, 100, Rose Grove Lane, Rose Grove, Burnley.

Birmingham: F. E. Shearman, 63, Summerfield Crescent, Edgbaston, Birmingham.

Sheffield and District: J. Dickinson, 157, Abbeyfield Road, Pitsmoor, Sheffield.

Scottish: J. Macfarlane, 3, Sharrocks Street, Ibrox, Glasgow.

London: F. E. Pitts, 41 & 42, Windmill Street, Tottenham Court Road, W.1.

Halifax: J. G. Robinson, 17, Gibraltar Road, Halifax.

Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.

East Midlands: H. Bunting, 17, Marcus Street Derby.

Peterborough: Ben Hird, 1, G. N. Station Road, Peterborough.

## Contents.

| | PAGE |
|---|---|
| Notes and Comments | 577 |
| Castings used in Ship Construction | 579 |
| Book Reviews | 584 |
| Silica Bricks | 585 |
| Sands for Iron and Steel Industry | 586 |
| British Foundry Association: Branch Meetings | 587 |
| Report on Hardness Testing: Relation between Ball Hardness and Scleroscope Hardness | 589 |
| Babbitt Metal and Babbitted Bearings | 594 |
| Fuel Economy in the Annealing Furnace | 595 |
| Zirconia—Its Possibilities in Metallurgy | 596 |
| The Boronic Deoxidising of Copper | 598 |
| The Wuerth Gas Producer | 600 |
| Annealing Pans | 601 |
| Trade Talk | 602 |
| Joint Consultative Committee on Labour | 605 |
| Machine Tools and Woodworking Machines | 605 |
| Personal | 606 |
| Applications for Patents | 606 |
| Returns as to Forgings and Castings | 606 |
| Deaths | 608 |
| Machine Tools | 608 |
| New Companies | 610 |
| Price List | 614 |
| Small Advertisements | 615 |

## NOTES AND COMMENTS.

### Standardisation of Trade Procedure.

An important subject relating to the standardisation of the laws and procedure affecting British trade and the form of British products (such as machinery and engineering products) throughout the Empire, was discussed at an interesting informal meeting recently held between the Prime Ministers of our Colonies, *i.e.*, Canada, Australia, New Zealand and Newfoundland, and certain representatives of the Federation of British Industries. This subject is acknowledged by manufacturers throughout the country as one of the greatest importance, for, to-day, the small divergencies in the local laws and regulations hamper importers, while in regard to laws affecting forms of products the existence of divergent regulations makes standardisation impossible in many cases, so that it has in the past sometimes proved easier to obtain agreement to the standardisation of a product, than to arrange for standardisation of the regulations affecting it. One of the subjects of discussion was the desirability of establishing throughout the Empire a standard form of declaration which British manufacturers must make to secure the advantage of preferential custom rates. A model form of declaration has been drawn up by the Federation of British Industries, and is being submitted to the High Commissioners of the various Dominions. Another important subject dealt with which met with a very friendly reception by the Overseas Prime Ministers was the question of uniformity of British laws and procedure throughout the Empire. The advisability of an Empire Bill on the subject was discussed, and it was understood that the Ministers present would be willing to make recommendations to their own Governments with a view to arranging for technical representations to be sent to a joint Empire Conference to consider the drafting of same. In the above circumstances a suggestion to the President of the Board of Trade has been made by the Federation on the ground that it would be to the interest of British manufacturers if the Bill which the Board of Trade is expecting to present to the House on patent law were held over, and steps taken to summon a conference of representatives of different parts of the Empire with a view of putting the patent law and procedure of the Empire as far as possible on a uniform basis. A discussion which took place with regard to the standardisation of laws and regulations affecting the forms of British products disclosed many difficulties owing to the great diversity of legislation—federal, state, municipal and otherwise. A conclusion was reached that this question could hardly be dealt with as a whole in spite of the fact that it was one of great importance, but could be best approached through the medium of the British Engineers' Standard Association and their Overseas Committee, whose work is directly affected by the diversity of legislature. It was decided that the co-operation of the British Engineers' Standard Association should be invited for this purpose.

### Industrial Lessons of the War.

With the close of hostilities, industry generally will naturally have to give serious and immediate attention to putting its house in order. We have learned many lessons from the war, though not a few have yet to be applied in practice.

In the course of his inaugural address as the newly-

elected President of the West of Scotland Iron and Steel Institute, at Glasgow, last month, MR. M. L. SIMPSON reviewed the effect of the war upon industry generally and the iron and steel trade in particular. He said that the experience gained in the production of materials of war would be beneficial to the trade as a whole in times of peace. As to the future, it presented many problems and difficulties. For a time there might be heavy demand for their products in order to make up the world's wastage during the war, but in respect to that it had to be remembered that the world's output of iron and steel had increased, and wastage would probably be made up at a greater rate than would have been possible on a pre-war basis. Capital which had been destroyed would involve a higher level of taxation, and labour claimed a higher standard of living; the effect of these would be to raise the cost of manufacture, as increased labour costs would apply not only to products but to raw materials. To neutralise the effects of these increases the remedy was largely in the hands of the workmen. But the owners of works would also have a large part to play in the direction of providing improved labour-saving appliances for the more economic and efficient handling of the materials required in the manufacture of their products.

Another point touched upon by Mr. Simpson was the necessity for reducing to a minimum the consumption of fuel both in melting and heating furnaces. He referred to the pulverised fuel system which had been introduced in the United States, and said that in that country it was well beyond the experimental stage, as the annual consumption was something like 10,000,000 tons, 2,000,000 tons being used annually in the iron and steel industry. Good results had been obtained from low-grade bituminous anthracite, lignite, and even coke breeze. It was claimed that the coal could be crushed, dried, pulverised, and conveyed to furnaces more cheaply than it could be gasified.

With regard to future possible developments, the speaker remarked that, having regard to the increasing scarcity of hematite ores, any considerable expansions in the future would probably be in basic steel. The site of such a works should be on suitable ground, with ample railway facilities and adequate accommodation for raw materials. It should be as near as possible to the source of supply of the raw materials, and also near the markets for the finished products. Probably the best way to determine the size of the works was by first determining the dimensions of the mills. From that could be closely estimated the dimensions of the melting shop, and from that the number and capacity of the blast furnaces.

## Future of the Non-Ferrous Metal Trades.

The attitude of the brass trade generally towards organisation and the application of scientific help has often been criticised of late.

MR. F. C. A. H. LANTSBERRY, M.Sc. (Chairman of the Birmingham Local Section of the Institute of Metals), in an address recently before that body, remarked that in a Paper on "Turbine Blading," read before the parent Institute in 1915, Mr W. B. Parker, the research chemist of the B.T.H. pointed out some of the defects which existed in non-ferrous materials for that purpose, due to the apathy displayed by manufacturers towards the constant employment of scientific help. When similar trouble arose with steel-alloy blading, the steel manufacturers met the complaint in a broad-minded, highly creditable and effective manner, thanks to scientific control. That the ferrous industries had not hesitated to take full advantage of the accumulated knowledge of the non-ferrous metals was a fact which could not be disputed. At least a dozen non-ferrous metals were used in making steels for various purposes, whilst cutting tools made entirely from non-ferrous metals had been placed on the market. Annealing pans, formerly made wholly of iron or steel, were now made of non-ferrous metals. At the time of the inauguration of the Institute of Metals copper was thought to be peculiarly their own, but now wonderful results were claimed for copper steel. Principles which had been worked out for the benefit of the iron and steel industries should be studied and applied to the non-ferrous industry in so far as they were relevant. For example, by simple research with wax ingots, Mr. Harry Brearley deduced certain principles regarding the phenomenon of crystallisation and piping, which, when applied to the casting of steel, resulted in a noticeable increase in the soundness of the ingots produced. Now, if anything, the production of sound ingots in the non-ferrous industries was of even greater importance than in the steel industry, because of the greater value of the materials used. Surely if the principles evolved from the study of wax were applicable to steel, they were equally applicable to brass. Mr. Fletcher, a local engineer and metallurgist, had obtained very useful information with regard to the production of sound ingots by the study of slags.

At times we were apt to forget that the German nation had also acquired a considerable amount of new knowledge in the last four years; the very fact that they had been able to carry on so long under the adverse conditons which must have prevailed in their country was in itself sufficient proof that they had not been idle in technical research. The lessons they had learned would be applied with the utmost vigour in the pursuit of industry, and they would make an exceedingly bold bid to regain their position in the commercial world. Industry must pay detailed attention to the problems presented on the subject of waste. The subject naturally divided itself into (1) the prevention of waste; (2) the utilisation of unavoidable waste. The amount of waste caused by carelessness and lack of skill on the part of the workers was enormous. Carelessness could only be met adequately by improving the conditions under which the work was carried out, and improving the technical knowledge of the worker. In this respect a useful lesson might be learned from the success of the training centres which had been set up for women during the war. The establishment of proper training centres would go a long way towards arousing a real interest in the work, something on the lines of that possessed by the old craftsmen. One of the disabilities under which industry was bound to suffer during the period of reconstruction would be a serious shortage of the technicians of industry.

PROFESSOR T. TURNER, referring to the expected shortage of scientific men in industries, said that the Germans were under a similar apprehension. A large number of substitutes had been invented in Germany to supply the places of various metals. It was evident that after the war a great many of these substitutes would be retained in use, not merely on account of their cheapness, but also because they had been found to have useful intrinsic qualities.

---

**A WHITEMETAL FURNACE.**—The exhibits of the Monometer Manufacturing Company (1918), Limited (of Whitehouse Street, Aston, Birmingham), at the recent British Scientific Products Exhibition comprised a whitemetal melting furnace with mixer and heat regulator, a furnace for the heat-treatment of high-speed tools, a die-casting machine and oil and gas burners. It is claimed for the whitemetal furnace that it is so constructed that there are no losses by oxidation, whilst the heat controller ensures that the metal is not over-heated or burnt, and consequently it is not volatilised, which is responsible for high percentage losses in uncontrolled furnaces. The mixer ensures that the resultant alloy is perfectly homogeneous. The die-casting machine is also heat controlled. The high-speed tool furnace is stated to give perfectly even temperatures. The oil burner is arranged for consuming the Government pitch-creosote mixture recommended by the Ministry of Munitions.

# Castings Used in Ship Construction.

By Ben Shaw and James Edgar.

## Introductory.

The number of steel foundries that could cope with very large work was comparatively small at the beginning of the war, but it was probably sufficient for normal needs. As the necessity, however, for more ships has become imperative, the larger foundries have become congested with work, and small foundries have had to adapt themselves to a class of work not only differing in size but also in design from that to which they were accustomed. Steel is probably the most uncertain of the common metals to cast, and the construction of the necessary patterns and the subsequent moulding differ so much in large and small work, that successful results can only be obtained after considerable experience, or by the exercise of an essential with this class of work than with large engine work, because the designs are such that if the finished work yields, it is practically impossible to get it correct again. Although the metal is usually heavy, yet they are really delicate patterns. A level floor in the pattern shop is indispensable for this class of work, but this is easily made, and if the shop is too small, the work can be constructed in a convenient part of the foundry.

The case of many foundries is, that while they have a furnace, or cupola and converter, of sufficient capacity, they have made a speciality of small work; but there is no reason why such foundries should not undertake successfully large work, including the necessary patternmaking. In

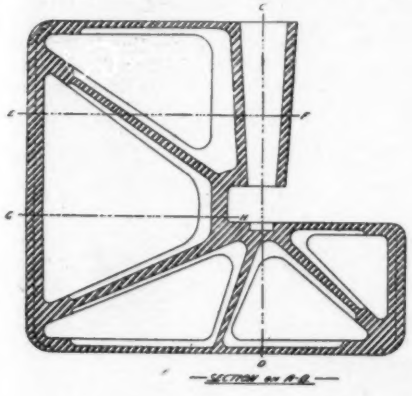



FIG. 1.

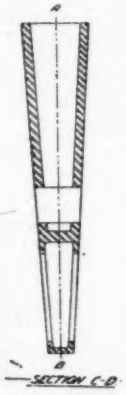
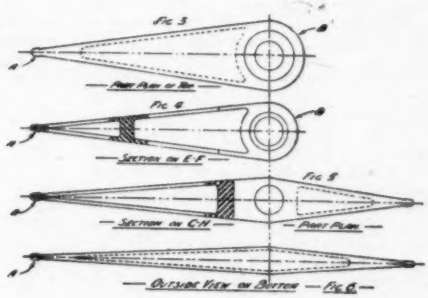



FIG. 2.




FIGS. 3 TO 6.

unusual degree of initiative. The writers know of one small jobbing foundry which has had many defective castings, and consequently has lost heavily; yet the plant is modern, and there is no reason, apart from the human factor, for the non-success.

In all moulding, but especially in moulding for steel, it is the little things that count. Unequal cooling, to mention one thing, has to be more guarded against than with other metals.

Occasionally the patterns for large steel work are conveyed by rail from the shipyard to the foundry if at a distance, but considerable delay is caused by this in addition to the danger of their being damaged in transit; consequently it is very common for the foundry to undertake the patternmaking. The necessity for accuracy in regard to the thickness of the metal in this class of work is not great, but angles are important. The patterns are difficult to handle because of their size, and as well as the patternmaker having thorough confidence in his own judgment, he must also possess the ability to so build the work as to obtain the maximum of strength. This is even more this connection there is less difference between iron and steel, than there is between iron and non-ferrous metals, and the average iron foundry can adapt itself to brasswork. Large iron foundries have practically all the plant necessary for steel work except a converter, and with a few experienced steel moulders ought to be able to cope with any steel work, however large. It is essential, of course, that a part of the foundry shold be reserved for steel work.

It is very improbable that the foundry that increases its plant so as to cope with large work, will have to revert to a small class of work after the war. Steel founding is still an immature industry. Before the war a great proportion of steel castings came from Germany and Sweden, but this is not likely to happen again. Steel is gradually displacing, not only iron but steel forgings, and there are indications that in the near future all turbine engine work, to mention only one class of castings, will be made in steel. The advantages are obvious. Apart from the additional strength, there is a great reduction in weight, which is of paramount consideration.

With regard to the relative merits of forgings and castings, it may be truly affirmed that each has positive advantages over the other, and there is continual disputing by experts as to which is the better. The balance of opinion now, however, is in favour of castings. Castings are generally cheaper, unless the design is very complicated, and this is true even when the patternmaking costs are heavy. The risk, however, is greater, because even with the greatest care bad castings do occur, causing delay in delivery, and this occasionally influences shipbuilders in favour of forgings. There is also an element of uncertainty with castings, as there are occasionally internal defects not noticeable on the face of the casting, but this danger can be almost entirely eliminated if care be taken in cooling. Also, is a mistake to suppose that forgings are not subject to internal strains; and welded joints on large work are not very reliable. Oftentimes, also, forgings are very expensive, because of the amount of machining that has to be done. There is a class of work that does not permit of an alternative method, and because of its design castings are necessary. Indeed the method of casting gives far greater scope to the designer. It is often possible to lighten the metal by coring, and to give a piece of work a more graceful shape if it is cast; an example of this is the propeller bracket, the " fish-back " or arm of which is frequently hollowed out.

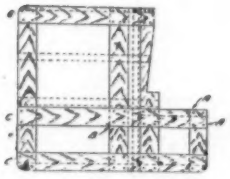


FIG. 7.

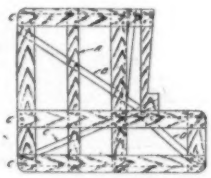


FIG. 8.

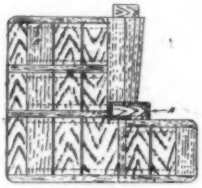


FIG. 9.

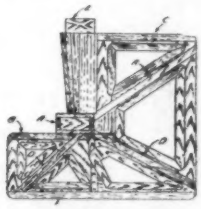


FIG. 10.

A very large treatise might be written on large steel casting, but in the following articles the commoner types and representative designs have been chosen, and where two methods are possible, they have been explained.

## Rudder.

### Making the Pattern.

A representative type of rudder is shown in Figs. 1 to 6. The outlines of rudders vary somewhat, but the main features of their design are the same, and the methods adopted in making the rudders shown are equally applicable to almost any rudder.

A glance at Figs. 1 and 2, bearing in mind that the height A B may be 12 or 14 ft., will give an idea of the fragility of the pattern, and the care which must be exercised in building it, to ensure that it will not break or twist. There are two ways in which the pattern may be made, and that adopted must depend on the foundry which is going to cast the work.

In some districts it is practice to make all large patterns for steel exact models of the finished casting, unless for circular cores, in which case the moulder makes his cores in place. The great advantage of this is, especially when dealing with awkward shapes, that the correct thickness of metal is assured, and another gain is that the moulder sees his work more clearly, and can mark his course at the beginning of the job with greater confidence. It is, however, a slow method. If a block pattern is made, and the cores are made in separate boxes, the work can be better distributed. The latter method is, however, the more expensive in the pattern shop, although the foundry is of course the first consideration.

We shall consider making a block pattern first, although the initial step is the same whichever method is adopted—the work must be set down. The common practice is for the moulding loft to supply the patternshop with a template. A drawing is provided, but for the main sizes, the template is more reliable, as it is frequently found necessary, when the frames are set out on the moulding-loft floor, to change the design in places. It is not necessary, however, nor is it advisable, to set the work out on a drawing board. The drawing should be done on the floor, and on the top of this drawing the work is built. The simplest way is to screw the template to the floor, and mark a line round it. The template is, of course, the finished shape of the rudder, and the patternmaker has to allow for contraction. The easiest way to do this is to draw the centre line C D, Fig. 1, and to measure all sizes at right angles to this line with a standard rule, and then transfer the size to the contraction rule. The sizes in the other direction, that is, in the height of the rudder can be measured from a base line. The section C D, Fig. 2, may be set down alongside the front elevation, but it is as well to put the other sections, Figs. 3, 4, 5, 6 on the top of the elevation. In painting the drawing, and it is necessary to do so, as it would otherwise become faint before the job is finished, the sections can be coloured differently to the main view.

For the purpose of this article we shall suppose that the whole job is being made by one or two men, although in the average shop quite a few men would be employed on it. The joint frames should be made first. It ought to be explained, however, that there is a considerable difference between the top and bottom halves. The prints are only put on the bottom half as they are unnecessary on the top half, apart from the danger of crushing when the cope is being lowered. A glance at Figs. 9 and 10 will show the reader the main differences. Fig. 9, which is the top, is covered all over, as it is easier for the patternmaker to cover it with plates than for the moulder to fill it with loam, but the bottom, on the other hand, does not need to be covered, it being sufficient to get bearing for the prints. The difference in construction begins with the joint frames. An

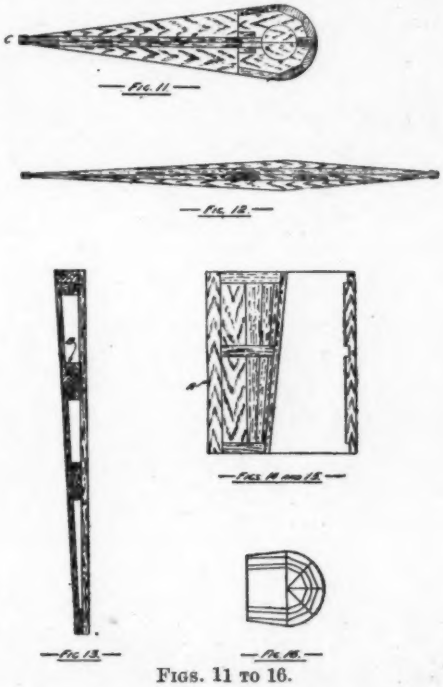
extra piece A, Fig. 8, is half lapped on the frames to support the ribs B, C and D. A similar piece could be put in the other frame, but it is not so necessary as this half when contracted has greater strength. These frames should not be of less thickness than 1⅛ in., thus allowing 1¼-in. screws to be used, and when the joints are cut there is a sufficient thickness to ensure rigidity. Care should be taken that the half laps are not too tight. It is rather peculiar that craftsmen who are careful to leave open joints when joining timber edge to edge will persist in making close half laps. Joints on the outside of a frame like A A, Fig. 7, may be close to preserve the correct shape of the frame, but all other joints like B, Fig. 7, where the side grain is enclosed on both sides, should be left 1-16th in. or ¼ in. open, according to the width of the rails. If this is not done, when the pattern goes into the damp sand the wood will swell, and the frame will warp and alter the shape of the whole job. The frames, when the work is finally shaped off, will be reduced considerably as C, Fig. 11, and the half laps at this end will have to be cut so that an equal joint will be left.

It is unwise, if not impossible to screw the joints C C C, Figs. 7 and 8, but it is not wise to rely upon glue only. The best job is obtained by using lead rivets. They are easily made, and as easily fixed. A piece of 3-16-in. or ¼-in. lead wire is procured, and cut to convenient lengths. When the holes are bored with a shell bit, a plate is placed under the frame, a rivet inserted and hammered down. It is an improvement to countersink the hole on the face of the frame. The lead rivets will either chisel or plane nicely. If lead wire is not handy, wooden pegs should be used. If ¼-in. holes are bored, and the pegs are made ¼-in. square and pointed, they will make a fairly strong job, but they cannot be compared with lead rivets.

The best way to make the boss B, Figs. 3 and 4, is to make grounds and screw staves on to them. Of course the inner side will be cored. An end view showing the construction is shown at Fig. 11. To get the correct shape of the grounds, and the taper of the staves it is advisable to set down an end view like Fig. 16. Three grounds are shown in Fig. 14, and they will probably be sufficient, but an extra one may be put in rather than have them more than 18 ins. apart. If they are too wide apart the lagging will yield. If the grounds are fairly thick, say 2 ins., the lagging need only be ¾ in. or ⅝ in. thick. It is as well to have one stay checked on to the face as seen at A, Fig. 14. A view of this stay is shown at Fig. 15. The circular portion of the barrels should be finished before they are screwed to the frames, but the flat top may be left full so that it can be planed off, when the pattern has been built.

Before the barrels are screwed in place the grounds which will define the shape of the rudder must be got out. They ought to be made of 2-in. timber. The grounds for the bottom half do not present any difficulty, as they may be placed where the sections are made. It would be quite possible when making the grounds, to allow for the ¾-in. covering plates or lagging, a it is sometimes called, to be screwed on top, but the alternative and probably stronger way is to make the grounds the full width, and after they are screwed in position to fit resting pieces for the lagging against them, B, Fig. 9. The great gain by this method is that there is no end grain to tear the mould when the pattern is being drawn.

A combination of the two methods is possible, of course, by making the outer grounds the full width, and reducing the inner ones, so that the lagging can be carried across, the only disadvantage of this being that the grounds cannot be tested with a straight edge as easily as when they are all the same height. The lagging can either be screwed or nailed, and open joints should be made. The barrel may be now screwed into position, and the entire top cleaned off with a plane. There is still the print A to make. It is as well to make a print on both top and bottom for this core. The danger of crushing this core is not very great, and having the top as well as a bottom print simplifies the making of the corebox. It will be seen that the top is set into the sides. A section of the print showing the sides checked for




Figs. 11 to 16.

the top is seen in Fig. 18. The principle involved in setting in the top, instead of making it to the outside of the print, and that which determined us to fit the body lagging to the inside of the outer grounds is the same.

It is never wise to have end grain and side grain together on the side of a mould. Even if the work is well painted and varnished, the side grain will shrink and swell, according as it absorbs moisture or is dried, and if it does not spoil the mould, it involves making up that can be avoided. It is not always possible, however, without involving much labour, to act on this principle, as, for example, a barrel end where staves are carried across to the outside of the grounds, but whenever possible the grain of different thicknesses of timber should not be crossed. Some craftsmen in jointing timber cross them in the belief that this is the best way to prevent the work warping, whereas the more effective way is to joint different thick-

nesses with the grain running in the same direction but back-to-back; that is, with the annular rings of the different pieces tangent to each other.

The top half being now finished, the bottom half may be proceeded with. The position of the grounds on this half, with the exception of the outer ones A B C, are determined by the shape of the cores. The correct shape of these diagonal grounds can be found by simple projection. Some craftsmen are content in a case of this kind to screw on the outer grounds, and after roughing down the diagonal grounds, to finish them off in place, using a straight edge across the job. This is a clumsy and slow way. The correct shape of the grounds should be drawn on the floor, on the top of the elevation when the timber can be placed on top lines squared up and the height marked. Joining the points with a steel rule, or a doctor, so as to get a sweet curve is a simple matter.

In Fig. 22 the outline of the rudder is shown,

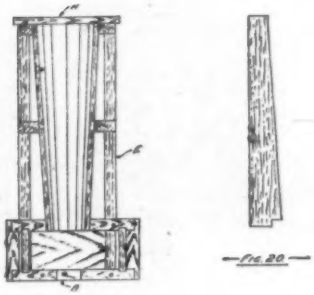



Fig. 19.

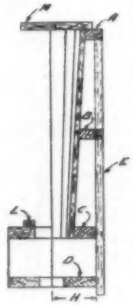


Fig. 21.

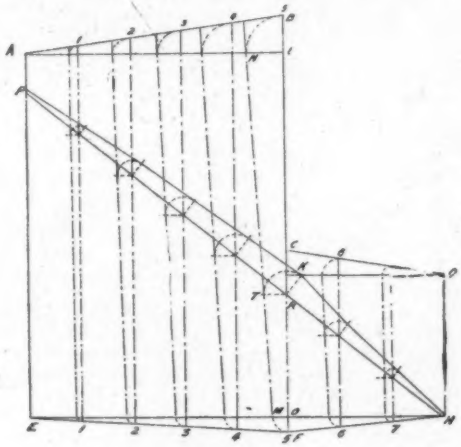


Fig. 22.

and the lines A B, C D, and E F H represent the shapes on the lines A L, K D, and E H respectively. Let us suppose we want to define the shape on the diagonal line P H. At the point R, where the perpendicular line intercepts the diagonal line, T R is drawn square to L O. With R as centre and R T as radius describe an arc and draw the line R K square to P H. The intersection of the arc with the square line gives the correct height of the diagonal line at R. The heights at the other points are obtained similarly. A number of lines parallel to A E must now be drawn. It is customary in practice to number those lines, and it saves confusion when transferring the sizes to the timber, the same numbers being used on the squared lines. With L as a centre and L B as radius describe the arc, and with O as centre and O F as radius, describe another arc. The points N M where those arcs intersect A L and E H and now joined.

When the core dividing ribs have all been marked off, they will have to be checked where they cross each other. It is better to keep them long and check them, then to carry one through and make a butt joint of the other. The joint frame depends upon these ribs for keeping it true. When they have been screwed in their correct positions, the boss will have to be fixed. It will be necessary to slot the grounds so that the boss will bed on to the frames, and it may be advisable to reduce that portion of the ribs within the boss, so that too great a depth will not require to be cut out of the grounds, thereby unduly weakening them. The print at A will also have to be fitted over the ribs. It is now necessary to screw strips against the ribs, just sufficiently wide to support the prints. Timber about 1 in. thick will suffice, and to prevent the danger of them being knocked in when the mould is being rammed, distance pieces may be fitted between the strips and the joint plate. In order to avoid getting an irregular surface, it is better to leave the print supporting strips just above the ribs, so that the whole surface can be planed, the print A being temporarily removed to permit of this being done. To get the correct shape of the prints, which need only be about $\frac{3}{4}$ in. thick, it is advisable to set out the shapes on the pattern, lifting the sizes from the floor drawing.

Strips of timber about 3 in. wide can now be fitted, mitred, and cut to shape. The print strips that are running diagonally will have to be made from thick timber, and after they are bedded down they can be gauged to a parallel thickness. The easiest way of bedding them to the pattern face is to support them on two blocks, resting on the pattern face and with the aid of hermaphrodites to gauge a parallel line. If care is taken very little fitting will be needed. There is still a thin strip, usually a $\frac{1}{4}$ in. thick, to be put round the pattern faces. It is shown at A, Figs. 3, 4, 5, 6. Rudders are balanced with spruce filling, and the plating which covers the whole faces is kept in position by means of this strip. When the end print E. Fig. 9, 10, is screwed on, the pattern is finished. This print should be about 3 in. thick to give a fair bearance for the core. A view of the finished pattern looking on the top of the boss is shown in Fig. 11 and a view looking on the bottom is shown at Fig. 12.

The coreboxes involve a very considerable amount of labour. It may be here mentioned that the core of the boss is usually rough turned at the foundry, but sufficient is left for a finishing cut. The reason for this is to ensure that the metal in the boss is sound, Figs. 19, 20 and 21 illustrate the corebox for the boss, Fig. 19 being a plan with the top half of the square box removed, and Fig. 21 is a section on the line A B, Fig. 19. The view Fig. 16 can be again used for getting out the grounds A B C and D, Fig. 21. These grounds should be at least 2 ins. thick. The box will be built on two bottom stays E, which are checked the full thickness into the grounds A and B. It is made narrower so that the bottom can be screwed between and outside of the stays.

The width of all the grounds is, of course, determined by the depth H, Fig. 21. Before building the staves into the grounds, it is well to cut the checks in grounds C for the ends of the square box. It is much easier to take these slots out at a band or a dimension saw than to cut them with a chisel when the box is half made. After the staves have been screwed in place and the top

necessitates making the bottom pieces the same thickness as the stays, and consequently very heavy.

As the method of constructing the five lighting coreboxes is the same, it will be sufficient to describe one. All these coreboxes should have bottoms. It is a great convenience to a moulder to have a bottom on a corebox. It may cheapen the pattern-making a litle not to trouble about bottoms, but the cost of making a bed in the foundry is greater. Fig. 23 shows a section of the topmost box on the line E F, Fig. 1. It differs from the others in having a block to complete the diameter of the box, otherwise the centre core would break through. In getting out these boxes the bottom should be made first.

It will be seen from Fig. 24 that the bottoms are open jointed and all the pieces are tapered. This is better for battening than making it of parallel widths. The sides of the box might be drawn off before being screwed together, but considerable difficulty may be experienced in getting the box quite correct when screwing it together. A more effective way is to make all the sides the width of the

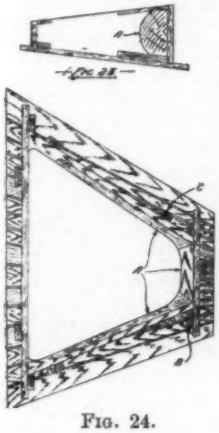


FIG. 24.

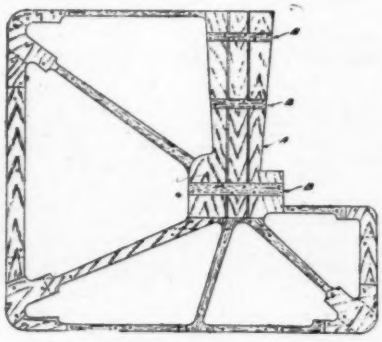


FIG. 25.

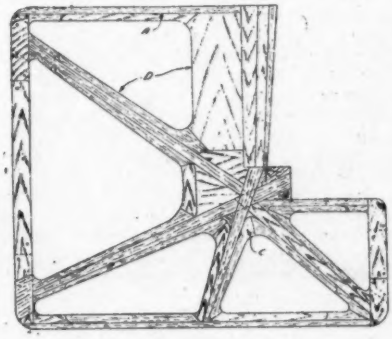


FIG. 26.

edges planed off flush with the grounds, the square end can be completed. It is just an ordinary framed box. It must, of course, be made in two, because of the circular holes in the sides, and the top will have to be dowelled to the bottom.

A full corebox might have been made for the whole box, but it is preferable to strickle the top half of the circular core. It simplifies the moulder's task when filling, and it is easier for him to make a grid. From the patternshop point of view also it is much cheaper. The strickle necessary is shown in Fig. 20. Some arrangement is necessary to guide the strickle. If it was a parallel core, a side guide and a semi-circular strickle would be the best way for the core-maker, but it is a tapered core, so there is practically no alternative to a long board. Segments L should be screwed to the outside of the square box at one end, and a ground M screwed at the outside of the box at the other end. The strickle will ride on these. When making the bottom grounds and staves for this box the strongest job is obtained by checking the stays into all the grounds alike. This, however,

deepest point of the box, Fig. 17. This enables the box to be tested on the drawing, and if correct, it is a simple matter to unscrew it, cut the sides to the correct shape, and put it together again. The depth of the box at the various points may be found by callipers; but if the pattern has been accurately made, the depth can be found geometrically in the same way as the dividing ribs for the bottom half of the pattern. The pieces A form the ribs in the top and bottom of the box, and the top pieces will have to be lessened by the coremaker. It will be seen that instead of checking the side, the bars B keep the sides in correct relation to each other. As the coremaker will have to loosen the sides, and draw them away from the core, they should not be screwed from the underside, but by means of blocks or buttons as seen in the sketch. These blocks may be 4 or 5 ins. long and about 2 ins. square.

We shall now consider the alternative method of making the pattern—that is, a pattern which is almost a replica of the casting. The pattern-maker's guiding thought right through the job must be to get the greatest strength possible, and it is difficult to make such a fragile piece of work

strongly. Two plates A, Fig. 25, will have to be made on which the boss will sit. Because of the shape it is not advisable to make an open frame, as it would not be as strong as a plate. The battens B ought to be let into the plate half the thickness, and if it can be obtained hard wood such as baywood, teak, sycamore, or maple should be used. The boss for each half will, of course, be a semi-diameter less the thickness of this joint plate. After the boss is screwed to the plate it will be well to place it on the working drawing, and build a frame against it to support the ribs that separate the cores. This is a delicate job. It will be readily seen that if the ribs were laid on the floor the full depth, it would be difficult to joint them so that when the pattern is lifted the whole work would be rigid. It is better to build two thicknesses of ¾-in. timber well jointed and screwed. Fig. 25 is a view showing the plate with the boss removed, and the skeleton-like groundwork with the joint arranged so as to give the greatest possible strength.

Fig. 26 shows the finished pattern. It will be seen that the boss is carried right through to the outside, but it is really better to keep it back the thickness of the rib A, so that this rib will help to bind the framework better by crossing the plate, and being screwed to the face of the boss. As will be seen from Fig. 26, the ribs are jointed across each other over the bottom plate. The necessity for this is obvious, as it is the chief means of binding the boss portion of the pattern to the outer skeleton. It will be as well now to make up the square shape at the foot of the boss. Solid blocks should be carefully fitted in, glued and screwed. The top print has been left off to show the construction. The fillets C, which should also be carefully fitted, help to keep the ribs rigid. All that remains to be done is to make and screw into position the ribs D. If the work is in a great hurry, it is possible to make the two halves at the same time and dowel them afterwards, but generally it is wiser to complete the construction of one half, although, of course, the pieces may all be finished at the same time before the other half is proceeded with. The completed portion can be turned over and the other half built on top of it. If the foundry is a considerable distance from the patternshop, it is wise to screw some edge bars across the pattern. The moulder can remove them before he starts his work.

There are so many loose pieces of ribs on the platform that it will save a great deal of trouble when the pattern has to be screwed together again to mark them carefully. Some patternshops are content with lettering loose pieces, but the pressed letters soon rise and cannot be seen, and paint marks are also seen obliterated. A good chisel cut or a V-tool mark is easily seen and will remain distinct as long as the pattern can be used.

**SUPPLY OF MATERIALS UNDER RATION SYSTEM.**—Under the ration permit system arrangements have been made for the supply of material for the manufacture of certain articles by means of an allocation for the entire trade. The scheme affects articles manufactured by members of the Brassfounders' Employers Association, the Cast-Iron Hollow-ware Makers' Association, the Wrought Hollow-ware Trade Employers' Association, the Edge Tool Makers, the Needles' Association, the Sheet Metalwork Manufacturers' Association (Domestic Tinware), and the Lighter Steel Industries (Nos. 2 and 3 Sections).

## Book Reviews.

**Works Lighting.** By DANIEL H. OGLEY.—London: Iliffe & Sons, Limited, 20, Tudor Street, E.C.4. (7s. 6d. net, post free 7s. 10d.)

At the present time, when the conditions of the industrial worker are receiving close attention, the appearance of a good book, as the one before us, on the subject of factory lighting is most opportune. In the preface Professor Marchant, of the Liverpool University, himself a well-known authority on works lighting, states that the need for a reorganisation of some factories in respect of lighting is evident from certain figures quoted by another writer, according to which in a certain factory the average daylight illumination was 32-foot candles, with a minimum of 8.6-foot candles compared with only 0.6-foot candle, with the flat-flame gas burners used. The author himself quotes some interesting statistics from the United States as a result of investigations made in over 200 factories employing some 80,000 workpeople, by which it was shown that the percentage of spoilage of work done by artificial light was three times as great as that of work done in daylight. After showing that good lighting is an important factor in efficient works administration, the author discusses the characteristics of good lighting, and then deals with the modern development of gas lighting and with the progress of electric lighting up to date, with a useful section—sandwiched in between—devoted to the measurement of illumination with hints as to how to decide the number, position, size and distance of lighting units, and the choice of reflectors, a description of the different types of which is given. Oil lighting (including the Kitson lamp) and natural lighting are also dealt with in the same descriptive and analytical way, full use being made of photographs and other illustrations in all parts of the book to amplify the text. There is a good index.

**Brassfounding.**—By JOSEPH G. HORNER. Manchester: Emmott & Company, Limited, 65, King Street; and London: 39, Bedford Street, Strand, W.C.2. (5s. net.)

Recent literature in book-form dealing with the subject of brass-moulding and founding is scanty, if it exists at all. This has induced Mr. Horner, the well-known author of practical treatises on "Pattern Making," on "Practical Ironfounding," and similar subjects, and a frequent contributor to our technical papers, to write the volume under review, dealing with the leading principles and practice of a trade with which he has been closely associated. The substance of the book has already appeared in the "Mechanical World," but new matter relating to furnaces has been added, considerable space being given to descriptions of furnaces generally. Although not fully comprehensive, the treatise is intended to be reasonably complete, and includes chapters which will be of service not only to students and apprentices, but also to pattern makers and moulders. Sands are dealt with in the same chapter as furnaces and crucibles.

**SCIENTIFIC SOCIETIES AND ENEMY MEMBERS.**—At an inter-Allied conference on the future of International Organisation in Science recently held at Burlington House, a statement has been adopted to serve as a preamble to a number of resolutions dealing with the withdrawal of the Allied nations from existing international associations, and the formation of new ones to take their place. After dealing with the fact that in the past science has formed a bond strong enough to resist the strain of national antagonism, and that this bond was strengthened during the latter part of last century, it is stated that the representatives are forced to declare that they will not be able to resume personal relations in scientific matters with their enemies until the Central Powers renounce the political methods which have led to the atrocities that have shocked the civilised world and can be readmitted into the concert of civilised nations.

# Silica Bricks.

Messrs. H. Le Chatelier and B. Bogitch, in a Paper submitted to the French Academy of Sciences, investigate the cause why fireclay and silica bricks behave so differently when exposed to high temperatures. According to the authors' experiments clay bricks begin to soften between 1,300 and 1,400 deg. C., and at these and higher temperatures their power of resistance gradually decreases in proportion to the increase in the temperature; they behave more like vitreous substances —that is, they do not show a well-defined fusion point but only a very long range of fusibility. The supposed fusing point of pure kaolinite at 1,780 deg. C. is the same as that of quartz. To explain the difference in the behaviour of clay and silica bricks one has to suppose that the latter have a defined fusing point without preliminary softening. When a small clay cylinder is compressed at a temperature approaching 1,500 deg. C. it first begins to bulge out, assuming the shape of a cask, and is finally flattened out like a pancake with rounded edges without showing any sign of rupture during the whole test. After becoming cool again the compressed mass will recover its original hardness. In the case of silica, on the other hand, the test piece will at first show no appreciable sign of yielding, but with increasing pressure it will suddenly collapse, the fractured surfaces assuming the well-known shapes of solid and hollow cones characteristic of all crushed hard substances. During cooling the fractured surfaces do not join together again. The pressure necessary to produce this sudden collapse decreases gradually with increasing temperature. The following table gives the crushing strength of a good silica brick of American make at various temperatures:—

| Temperature, deg. C. | 15 | 520 | 670 | 800 | 950 |
|---|---|---|---|---|---|
| Crushing strength, lbs. per sq. in. .. .. | 2,418 | 2,247 | 2,134 | 1,977 | 1,778 |

| Temperature, deg. C. .. | 1,050 | 1,200 | 1,320 | 1,460 | 1,540 | 1,600 |
|---|---|---|---|---|---|---|
| Crushing strength, lbs. per sq. in. .. | 1,707 | 1,209 | 882 | 711 | 526 | 427 |

Plotting a graph with these figures and extending the curve to 1,700 deg. C. (the usual temperature in steel furnaces), the crushing strength at this temperature will be found to be equal to about 171 lbs. per sq. in. Silica bricks, therefore, have a factor of safety of about 10 under the comparatively small loads they have to sustain in a furnace.

The ability to bear a load until the critical pressure is reached is a characteristic feature of silica brick not shared even by magnesite bricks. The authors' explanation of this is that in the case of both the clay and magnesite bricks the basic oxides included in the principal refractory material fuse and become liquid at a temperature of about 1,200 deg. C. Now, in the case of magnesite bricks the solid magnesite particles float in the liquid mass, and easily glide over one another as in the case of wet sand. The silica, on the other hand, at least in well-burned bricks, retains a continuous (and coherent) honeycomb-like framework in the interstices of which the fused mass remains lodged without reducing the mechanical strength of the frame itself, as, *e.g.*, water will lodge in the pores of pumice-stone without affecting its strength. The formation of this framework consequent upon the re-crystallisation of the silica is, as one of the authors has already explained on a former occasion, due to the various degrees of solubility of the different allotropic varieties of silica. Quartz being unstable at high temperatures is dissolved in the fluid residue (the magma) and re-crystallises first as cristobalite and subsequently as tridymite. This re-crystallisation requires prolonged heating to the proper temperature and a maintenance of this temperature for a sufficiently long period. In underburned silica bricks the solid framework is not yet formed, the solid particles of quartz float in the fluid mass, and hence the bricks are plastic like magnesite and clay bricks. It is a well-known fact among makers that underburned bricks are fusible and of little use.

*Proportion of Fusible Oxides.*—The authors next give the analyses of three bricks which, they were told, had given particularly satisfactory results in practice. The subjoined table shows the percentages of weight of basic oxides as well as of the total weights of sulphates obtained by treatment with hydrofluoric acid and evaporation after adding some sulphuric acid to the solution:—

| Brand or mark. | $Al_2O_3$. | $Fe_2O_3$. | CaO. | MgO & $K_2O$ | Total. | Sulphates |
|---|---|---|---|---|---|---|
| Star .. .. | 0.94 | 0.15 | 1.79 | 0.50 | 3.38 | 9.06 |
| Assailly .. | 2.72 | 1.30 | 0.20 | 0.25 | 4.47 | 13.60 |
| G.I. .. .. | 1.02 | 0.60 | 1.48 | 0 | 3.10 | 8.40 |

The "Star" brick was said to have given the best results in actual work. The Assailly brick was made some 30 years ago, and had formed part of the lining for one year of a gas flue in a steelworks furnace. It was this specimen that led one of the authors to the discovery of the transformation of quartz into tridymite in bricks after prolonged heating. Finally the G.I. brick is a brand that is considered one of the best made at present in France. The table shows that the total weight of the oxides forms, on an average, about 35 per cent. of the weight of the sulphates. This test can be made quickly, and will suffice to enable one to form an opinion about the composition of a silica brick.

*Kiln Temperature.*—Experience has proved that silica bricks must be kept at a temperature of about 1,450 deg. C. for several days. The temperature must be kept below that at which the quartz is quickly and in a direct way turned into cristobalite. In order to aid the quicker and more complete formation of the framework already referred to, the mixture for making silica bricks should chiefly consist of fine, and even very fine, quartz. A certain amount of coarse-grained material is, however, required to prevent cracks, which will extend quickly in a uniformly fine-ground material.

*Disintegration.*—If after being burned there should remain in the brick grains of untransformed quartz, and the brick is rapidly heated to a temperature at which a quick transformation of the quartz takes place, the swelling caused thereby will quickly destroy the framework and the brick will crumble to pieces. Moreover, as the pressure to which the brick is exposed in the arch will pre-

vent any swelling laterally, the material will scale off and the arch probably will be destroyed in a few days, when it ought to have stood some months' service. When silica bricks are properly burned they will swell in the course of manufacture, but the material in the kiln has room to expand freely in every direction and, besides, the process of transformation will be slow and the framework, if ruptured, will have time to join up again. The mechanical strength of the brick must, however, suffer under the process.

Finally, the authors publish the results of tests obtained with 13 bricks (6 of them described as of very good quality, 2 good, 1 indifferent, 2 bad, and 2 very bad), which led them to form the opinion that all good silica bricks, after being kept at a temperature of 1,600 deg. C. will retain a crushing strength of at least 142 lbs. per sq. in., and that a prolonged exposure to this temperature will only reduce their mechanical strength slightly, while bricks of an inferior or bad quality will fuse, crumble to pieces, or have very little mechanical strength left after such heat treatment (maximum in the table about 71 lbs. per sq. in.).

---

**THE LEAD CONVENTION.**—The Lead Convention, says the "Freight and Metal World," was a very conningly-thought-out piece of work, and there is no getting away from the fact that its workings were very prejudicial to the welfare of the lead consumers in this country. It was obviously a German invention. In any case, during the years which saw it in existence, viz., from 1909 to June, 1915, very large sums of money were taken out of the pockets of British lead consumers, while British interests in another direction were also seriously compromised. The scheme in itself was so simple that it is surprising that the business people, and more especially the metal users, of this country did not see through it and organise against it. German concerns held very large interests in the lead mines in Spain and elsewhere, and as prime producers of metallic ores in all parts of the world, including Mexico, China, etc., they were in a position to manipulate the market and make handsome profits. The lead manufacturer and also every other small consumer of lead in this country was placed in an unenviable position, as they only had to work upon the small margin of profit between what they were forced to pay for their raw material in the shape of soft pig-lead and what they could obtain for the finished product of which this formed the base. The prime producers, who before the war were principally German, aimed at high prices for the lead they marketed, and it is perfectly obvious that if mining costs, royalties, interest, transport charges, establishment costs, etc., were only £10 to £12 per ton the profits gained would be enormous. The Convention never maintained any stocks of lead in this country—an important condition in the event of war—so, therefore, by allowing the German interests to have almost complete control over the situation, Great Britain was placed in a dangerous position. The average selling price of soft foreign pig-lead in the United Kingdom, together with the imports into this country and the world's output, were as under:—

| | Lead imports into U.K. Tons. | Average selling price of soft foreign pig-lead. £ s. d. | World's lead output. Metric tons |
|---|---|---|---|
| 1907 ... ... | 204,695 | 19 1 9 | 1,027,000 |
| 1908 ... ... | 237,508 | 13 10 5 | 1,077,000 |
| 1909 ... ... | 207,660 | 13 1 8 | 1,092,000 |
| 1910 ... ... | 218,936 | 12 19 1 | 1,139,700 |
| 1911 ... ... | 213,707 | 13 19 3 | 1,117,800 |
| 1912 ... ... | 205,375 | 17 15 10 | 1,189,100 |
| 1913 ... ... | 204,136 | 18 19 4 | 1,186,700 |

## Sands for Iron and Steel Industry.

Iron and steel makers were fortunate before the war—says PROF. P. G. H. BOSWELL in a "Memoir on British Resources of Refractory Sands" before us—in having been able to draw upon Continental supplies of raw siliceous materials. The approximate constancy in grade and chemical composition in the case of both moulding and furnace sands made any need for analysis and investigation apparently superfluous. Yet in no other industry perhaps is the assistance provided by works' chemists and laboratories more assiduously cultivated. It would not have been a difficult matter for the chemist to have become interested in the sands upon which the success of the foundry so largely depended. Much more attention, however, is now being paid to sands in a few of the more progressive works, and the problems concerned with that commodity have been put into the hands of competent scientific assistants. Nevertheless, Prof. Boswell thinks, more chemists are needed in the works, and it would be to the interest of every firm to see that at least one assistant had received some elementary training in geology. A closer check upon the raw materials brought into the works, in his opinion, is very desirable. The discussion of the uses and nature of sands and of the methods of study, together with the requirements of good silica and moulding sands, has been expounded in his Memoir under review, which has been published at the instruction of the Ministry of Munitions by the Imperial College of Science and Technology and the University of Liverpool with the view of aiding those concerned with metallurgical practice to investigate sands for themselves.

In 1913 some 273,352 tons of sand, valued at £103,095, were imported into the United Kingdom, of which 233,754 tons came from Belgium and 35,157 tons from France. In 1915 the total imports have sunk to 102,103 tons, of which 35,043 were received from Belgium and 33,662 tons from France. With the exception of a little special moulding sand, the imported material may be taken to have been high-silica sand for glass making and for furnace purposes. The figures tell their own tale of war. The margin of profit on sands is small. When brought over as ballast or as packing for bottles, Belgian and Dutch silica sands could be formerly delivered on our East Coast at from 4s. to 5s. per ton. French and Belgian moulding sands were similarly delivered into manufacturing areas (although they were not usually brought as ballast) at 12s. to 18s. per ton. Even then the prices were below those of British sands, as the cost of production of the latter was greater, as a rule. Since the outbreak of war, partly owing to the greater demand for British materials and partly as a result of certain facilities having been granted permitting cheaper working, British sands are being delivered at a price which will enable them to compete successfully with foreign supplies. This improvement has been effected and a systematic development made possible by the high cost of foreign sands which rules at the present day. Belgian and Dutch silica sands, when procurable at all, cost 17s. to 23s. per ton, according to the position of the manufacturing area. Belgian moulding sand came from near Mons and Charleroi, still in enemy occupation. The "French red" and "yellow" sands from Fontenay-aux-Roses and from other localities west and south-west of Paris were shipped from Rouen. The price in steel-making districts such as Sheffield was 30s. per ton in 1917. Professor Boswell thinks that even when prices return to about their normal level it will be possible for British sand merchants to exploit their pits if the demand is sufficient and if railway and canal facilities are given.

The Memoir is divided into 12 chapters, the first four of which deal with the various uses of sands and the various industrial purposes for which they are required, and describe their nature and the methods of studying them. In the next chapter are set out the

requirements, the various kinds of refractory sands—high-silica sands and naturally bonded moulding sands—have to fulfil. Leighton Buzzard sand belongs to the former, "Belgian yellow" sand to the latter class. Further, three chapters enumerate the localities where both kinds of sands can be found, including the red moulding sands of the Bunter. Several sketch-maps showing these localities are to be found at the end of the volume. The treatment, and preparation for use, of refractory sands, foreign refractory sands (French, Belgian, Dutch, American, South-African) and the location of British supplies of furnace and foundry sands are dealt with in further three chapters, and the last of all is devoted to economic considerations, statistics, etc. The volume is fully illustrated, and there is a good index.

In the opinion of many—the author amongst them—who have had occasion to look into the question of the future of the steel industry in this country, the shortage of hematite ore and the resultant compulsory utilisation of low-grade phosphoric iron ores to a gradually increasing extent spells the development of the basic steel industry and the eventual decline of the acid process. If such should be the case, the demand for basic refractories for furnace linings will enormously increase, and the manufacture of silica bricks and high-silica sands will necessarily decline also, although the demand for them may not cease entirely. Whether basic or acid steel will hold the field, the requirements, at any rate, of moulding sands will increase with the enhanced call for castings. So far as acid steel itself is concerned the open-hearth process, producing as it does in larger quantities and at a lower temperature (and consequently less exacting upon refractories than the converter methods) is undoubtedly developing rapidly.

The agents for the sale of the volume are Messrs. Taylor & Francis, of Red Lion Court, Fleet Street, London, E.C.4. The price is 8s. 6d. net.

## British Foundrymen's Association.

### PETERBOROUGH BRANCH.

The programme of this Branch for the current session is as follows:—

November 9.—"A Talk about the Cupola," by Robert Buchanan.

December 14.—"Cast Iron," by F. J. Cook.

January 12, 1919.—"Jolt Ramming Jobs," by Ben Hird.

February 9.—"Loam Moulding," by J. Shaw.

March 9.—Lecture by R. Carrick.

April 13.—Open discussion.

Visits to works will be arranged and announced in due course.

### BIRMINGHAM BRANCH.

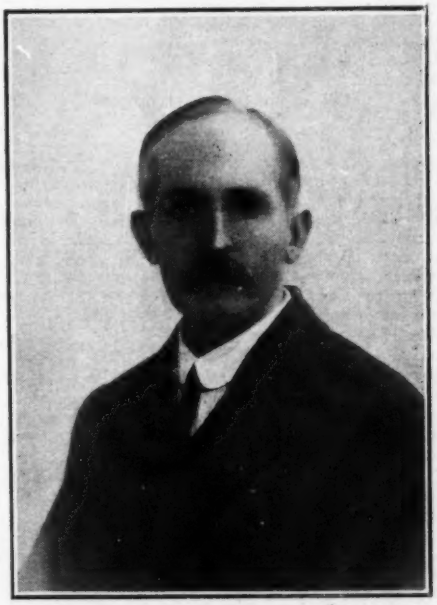
At the opening meeting of this Branch, on October 26, Mr. J. J. Howell, Branch President, discussed the subject of "The Foundry Apprentice." The address and the discussion following thereon will be dealt with in our next issue.

### SCOTTISH BRANCH.

The first meeting of the 1918-1919 session of the Scottish Branch of the British Foundrymen's Association was held at Glasgow on October 12. Mr. R. R. McGowan occupied the chair.

In the course of his introductory remarks, Mr. McGowan made reference to the appointment of Mr. Matthew Riddell as a Vice-President of the parent Association. Mr. Riddell had shown during his term of office as President of the Scottish Branch that he possessed many of the qualifications which an ideal president should possess, and he (Mr. McGowan) was certain, when the occasion arrived for Mr. Riddell to take the chair of the parent Association, his work would meet with as much acceptance as it had done during the three years he was President of the Scottish Branch.

Intimation was made of an arrangement which had been come to with the West of Scotland Iron and Steel Institute, whereby the members of that Society had the right of attending the meetings of the Scottish Branch of the British Foundrymen's Association, and the members of the Scottish Branch of the British Foundrymen's Association had a similar privilege with regard to the meetings of the West of Scotland Iron and Steel Institute. The President also stated that the Council of the Scottish Branch had been considering some schemes to try and extend the usefulness of and



Mr. R. R. McGowan (President of Scottish Branch of British Foundrymen's Association).

increase the membership of that Branch. One scheme suggested was to have, as far as possible, a representative member in every foundry in Scotland.

Mr. R. R. McGowan then proceeded to deliver his presidential address on "Education and Industry." This will be dealt with in our next issue.

The Secretary, Mr. J. Macfarlane, 3, Sharrocks Street, Ibrox, Glasgow, has issued the Branch programme (particulars of which were published in our last issue) in booklet form, including therein a lot of general information and technical data of a useful nature. The programme of the West of Scotland Iron and Steel Institute is included, and a considerable amount of other matter of value to the foundry trade. Herewith we reproduce a photograph of the Branch President, Mr. R. R. McGowan.

## LONDON BRANCH.

The following is the London Branch programme for the remainder of the session :—

November 15.—" Manufacture of Steel Castings by Various Processes," by D. D. McGuffie.

December 20.—Meeting; particulars later.

January 17, 1919.—" Foundry Comparisons," by H. J. Barrett.

February 21.—Paper by J. E. Hurst.

March 21.—" Equipment for a Physical Testing Laboratory," by J. S. G. Primrose.

April 18.—" Heat Treatment and Mechanical Testing of Steel and other Engineering Materials," by E. M. Boote.

## SHEFFIELD BRANCH.

This Branch programme is as follows :—

November 29.—" Deformation of Castings," by T. Brown.

December 20.—" Foundry Practice," by C. Webster.

January 31, 1919.—" Welding," by Eng. Lieut.-Commander L. Jackson, R.N.

February 28.—" Refractory Materials," by Prof. Boswell (the University, Liverpool).

## NEWCASTLE BRANCH.

The annual meeting of the Newcastle Branch of the British Foundrymen's Association was held on Saturday, September 28, 1918, in the Mining Institute, Newcastle. Mr. W. Mathews, the retiring President, occupied the chair, and there was a large attendance.

The Honorary Secretary (Mr. H. A. J. Rang) submitted the annual report, which stated :—Eight meetings have been held during the past session, and it is pleasing to observe that the attendances have shown a marked improvement on previous years. This is very encouraging to the Council, and indicates a more lively interest in the lectures, discussions, and the work of our Branch generally. The summer outing was a most enjoyable one. The thanks of the Association for the success of this pleasant excursion are due to Mr. and Mrs. Gallon for their invitation and hospitality on this occasion.

During the session some excellent papers have been given on subjects of more than passing interest. The " open discussion " nights were also well attended, and interesting and valuable information imparted.

The membership is increasing satisfactorily, and now totals 129, made up as follows :—Members, 37; Associate Members, 64; Associates, 28. This is an increase of 13 on the previous year. Taking the district under our charge, we should have no less than 500 to 600 members, and it is the desire of the Council, and certainly of every active member, that we make greater efforts for an increased membership.

In regard to the Surtees' Memorial, the money so far received has been invested in War Loan :—W. Mayer, Dumbarton, £25; M. E. Gallon, Dunston-on-Tyne, £5; H. A. J. Rang, N. Shields, £2 2s.; H. J. Young, Wallsend-on-Tyne (annual for five years), £1 11s. 6d.; W. Henderson, 6, Rosewood Crescent, Walkerville, £3 3s. Now that it is generally recognised that the training of apprentices is one of the main issues to be considered in craftsmen of the future, also to enable us, as a nation, to hold the high position in the world's affairs in the future, it is necessary that this scheme be now seriously considered, and donations, gifts and subscriptions be sent in, so that a definite scheme may be decided upon at the earliest possible moment.

We much regret the loss of one of our members, Mr. Greville Jones, general manager at Port Clarence Iron Works. The Council take pleasure in referring to the distinctions conferred by the King upon R. Wallis, Esq., M.B.E., Wh.Sc.; G. Vardy, Esq., M.B.E.; T. MacPherson, Esq., M.B.E.

The report was adopted.

The following officers were appointed for the ensuing year :—President, Mr. J. D. Carmichael; Senior Vice-President, Mr. E. Smith; Junior Vice-President, Mr. George Vardy; Delegates, Messrs. E. Smith and E. Tait; Council, Messrs. H. F. Parsons, J. Clark, J. W. Frier, and W. T. Archer; Hon. Secretary, Mr. H. A. J. Rang.

The retiring president, Mr. Mathews, presented to the Association a base and black ebony hammer, suitably inscribed with the names of the past-Presidents of the Association and the Secretary.

Votes of thanks were accorded to the officers for their services during the past year.

The newly-elected President then delivered his address, which will be dealt with in our next issue.

The Branch programme is as follows :—

November 30.—" Moulding of Spur Wheels," by M. E. Gallon (Dunston).

December 14.—Paper by S. W. Wise (Heaton).

January 25, 1919.—" A Consideration of the Properties of Two Cast-Iron Test Bars," by H. J. Young, F.I.C.

February 22.—Meeting; particulars later.

March 29.—Open discussion.

Visits to local works and other places of interest will be arranged as opportunity offers.

## LANCASHIRE BRANCH.

A meeting of this Branch was held on October 5, when Mr. Samuel Roe, Branch President, delivered an address on " The Training of Apprentices." This will be dealt with in our next issue.

**KING'S FUND FOR DISABLED.**—The King's Fund for Disabled Officers and Men of the Navy, Army and Air Force opened by His Majesty with a gift of £78,000, is designed by the Minister of Pensions, the Rt. Hon John Hodge, to raise a minimum of £3,000,000 to re-establish in civil life those gallant Britons who have fought and suffered for their country and for civilisation. This fund is wholly apart from any State aid, and is a voluntary monument of the nation's gratitude to our heroes who, disabled as fighters, have now to be re-established in civil occupations. The loss of limbs and other physical disabilities make the battle of life difficult for them, and the King's Fund, which is dealing with some 600 cases a week, provides grants of various sums to enable those who have given so much for us again to start life as contented, self-supporting citizens. Donations will be received gratefully by the Minister of Pensions, Westminster House, London, S.W.1. Already there has been a response of over £400,000 to the appeal of the King's Fund, but much remains to be done. A multitude of organisations are lending their aid, and, in particular, contributions are being arranged by the great trade of organisations.

# Report on Hardness Testing: Relation between Ball Hardness and Scleroscope Hardness.*

By A. F. Shore (New York, U.S.A.).

In an Introduction to this Paper by Sir Robert Hadfield, he recalls how at the May Meeting of the Iron and Steel Institute he communicated the substance of a telegram he had received from Mr. Shore dealing with the relation between ball hardness and scleroscope hardness. This telegram was the outcome of investigations made during the last few years on the subject of hardness determination, and of correspondence between Mr. Shore and himself. He (Sir Robert) was at that time investigating hardness tests, particularly in the higher ranges, in the Hadfield Research Laboratory in Sheffield, with the object of finding a satisfactory factor for converting Brinell hardness numbers to scleroscope numbers and *vice versa*. In the course of the correspondence referred to, the following questions were formulated and sent to Mr. Shore from the Hadfield Research Laboratory:—

(1) Is it possible to find the relation between ball hardness, commencing with 150 up to 800, and scleroscope degrees? Also for each advance of, say, 50 Brinell hardness numbers, what is the difference in scleroscope numbers, and what is the necessary factor to convert each of these from Brinell into scleroscope numbers, and *vice versa*.

(2) Can a special scleroscope be supplied for determining in Brinell numbers instead of scleroscope, or both, highly hardened products ranging from 550 to 750 Brinell ball? The figures now obtained from the present apparatus do not appear altogether reliable. The scleroscope appears not to read to such a fine point as the Brinell.

Mr. Shore's replies having now been received, form the subject of the Report which follows.

## Report on Hardness Testing.

With the object of throwing a light on the subject of the questions received from Sir Robert Hadfield, the author has undertaken an elaborate series of experiments, the results of which are shown graphically in the accompanying Charts I., II., and III. A wide variety of metals, with different states of heat-treatment and both ferrous and non-ferrous, were selected. The charts bear on the following aspects of this subject:—

*Chart I.*—Relation between scleroscope and ball tests from the hardest to the soft metals, using 3,000 kg. throughout under a 10-mm. steel ball.

*Chart II.*—Relation of ball test and scleroscope, using 62 kg., 250 kg., 500 kg., and 750 kg., respectively. Above 325 Brinell or 60 scleroscope, a diamond sphere 10 mm. in diameter was used, because of the flattening of the steel ball.

*Chart III.*—The scleroscope against the number of pounds required to cause a 10-mm. ball impression of 1 mm. in diameter from the softest to the hardest metals. In this instance the depth and diameter of impressions were constant, while the pressure was the variable factor.

*Explanation of Chart I.*—Curve A. It was not found possible to obtain a satisfactory conversion curve, as its wavy appearance indicates. More than this, the readings were widely scattered. This is probably due to the use of excessive pressures. From approximately 700 Brinell to 550, wide discrepancies are caused by flattening of the ball. From 550 down to about 200 Brinell, abnormally high readings are obtained, due to the superhardening of this series of metals, which are necessarily possessed of marked toughness. Below 250 similar superhardening occurs, but Brinell reading have a tendency to fall below the best average line, because the superhardening is neutralised by flow in the metal.

*Explanation of Chart II.*—Curve B, B′, C, C′, was produced by the pressures indexed in the chart, by the use of a steel ball. It was very difficult to read the impressions on steels above 80 hard scleroscope. It was soon observed that, using a steel ball above 450 Brinell or 85 scleroscope, a pressure of 750 kg. was insufficient. Hence the diamond sphere previously referred to was used. This pressure, and even 500 kg., was now sufficient, and enabled the curve B, B′, to be continued up to nearly 800 Brinell, with what the author regards as unusual consistency in its agreement with the scleroscope at the ratio graphically shown.

*Explanation of Chart III.*—In the abscissæ of this chart, the scleroscope numbers are used, while in the ordinates the number of pounds required to produce an impression 1 mm. in diameter, using a 10-mm. ball, are used. Curve E, therefore, represents a co-ordination of these values. The constant diameter and variable pressure system has been adopted, because this is theoretically the correct way of measuring absolute hardness under the resistance to penetration principle, and is therefore used as a mean of investigating the scleroscope scale. It may just as well be used to investigate the Brinell scale.

In the past the author contented himself with checking up the Brinell method with the scleroscope and *vice versa*. The time has now come when both methods have been more or less questioned, particularly on the higher ranges of hardness, and hence the importance of curve E, which appears to supply the data necessary.

*Use of a Steel Ball versus a Diamond Ball.*—Quenched carbon steel, 100 hard scleroscope, has a plane surface resistance to indentation of approximately 700,000 lbs. per sq. in., whereas Brinell pressure at the same hardness, using 3,000 kg., develops practically 1,000,000 lbs. per sq. in. A steel ball can only sustain this load by flattening out. The result will then be that the penetration will be one-third as much as it will be in annealed carbon steel for the same diameter of impression.

Above 85 hard scleroscope there appears to be a kind of adjustment between the steel ball and the sample under test, which has a tendency to cause an indentation having always the same diameter, regardless of a considerable variation of hardness of the said sample as indicated by the scleroscope, or as can be indicated by the Brinell method, using a diamond sphere.

Thinking that the flat on the steel ball which had been caused by previous tests might have been the cause of the lack of discrimination, a series

* Abstract of Paper read at the recent meeting of the Iron and Steel Institute.

CHART I.

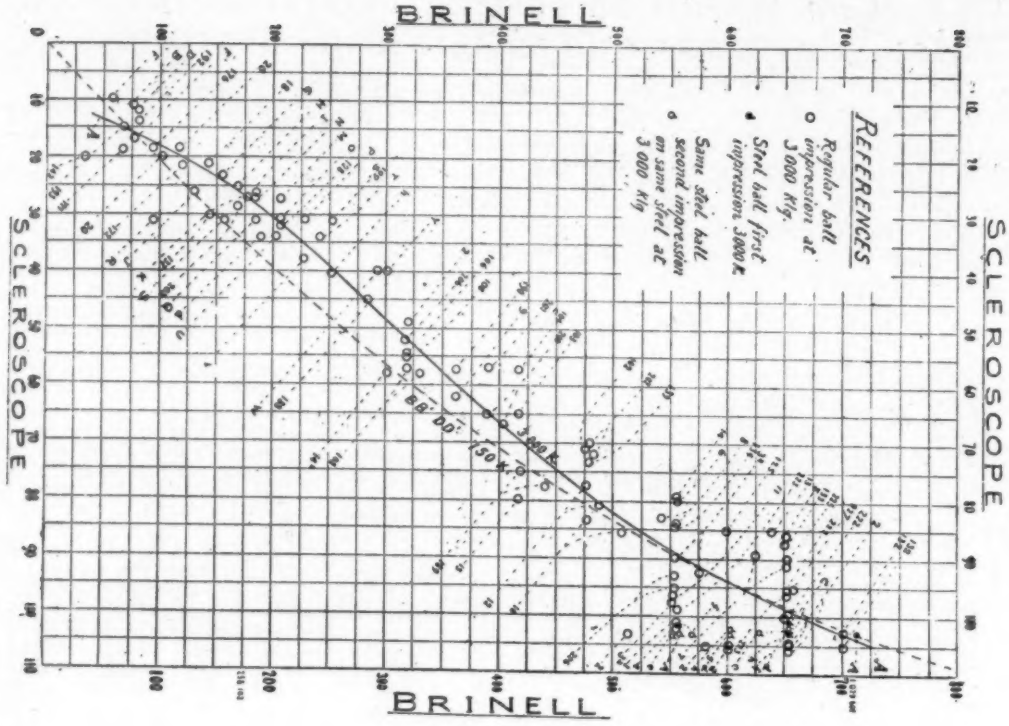
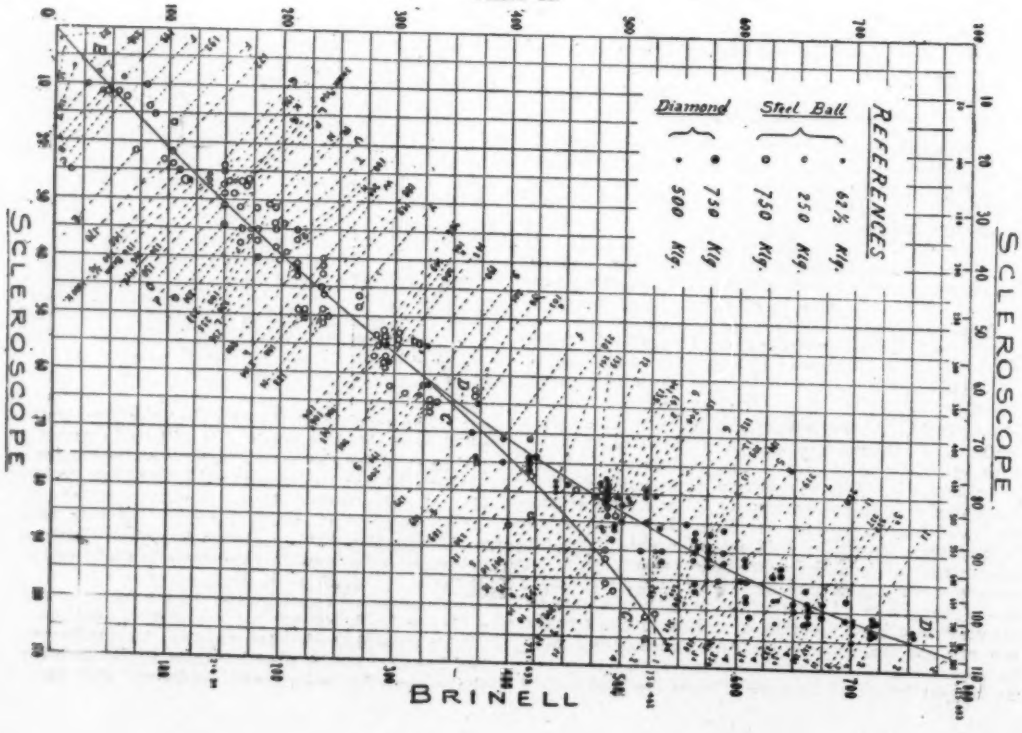



CHART II.



of tests were made on the same block of steel, using each time a new and round surface, followed by a second test, without changing. In other words, testing with the previously flattened ball, a difference of from 100 to 150 Brinell numbers could be obtained in this way, the flattened ball reading always lower than the unflattened ball. These impressions are illustrated in Chart I. The hardness of the ball used was 105 scleroscope, although the average run, as usually supplied to the trade, is about 100 hard.

As far as the author's experiments have gone, he has been led to the conclusion that by the use of a steel ball no consistent results can be obtained above 85 hard scleroscope. By the use of a diamond, at a pressure of 750 kg., the value of the most intensely hard steel can be ascertained as per his curve B, B′, D, D′. The diamond (yellow) has a resistance of approximately 1,250,000 lbs. to 2,000,000 lbs. to the sq. in., provided, of course, it has been carefully selected and its cleavage planes are at right-angles to the plane of the test sample. The highest pressure employed on carbon steel 105 hard in Chart II. was 1,125,693 lbs., thus showing that it is dangerously close to the limit. While it has thus been shown that the diamond can be used under the Brinell press measuring steel at its highest hardness, it hardly lends itself to commercial application for the following reasons: (1) The indentations made are so small as to be extremely difficult to read even under perfect laboratory conditions. (2) The loss due to breakage of diamonds would almost be prohibitive. In the experiments the regular hydraulic Brinell testing machine was not considered as accurate enough for the use of the diamond under 750 kg. An ordinary beam weighing scale arrangement was substituted. One or two seconds of time was allowed; more time did not materially influence the results.

*Relation of Scleroscope to Brinell.*—Curve B, B′, D, D′, is regarded as one indicating with as much accuracy as can be reasonably expected the true relation between scleroscope and Brinell methods. It is readily seen that the relation is a sliding one. Assuming that the diamond could be made to stand up better than it does under 750 kg., the pressure curve B, B′, D, D′ would appear to substantiate Sir Robert Hadfield's claim that on the higher hardnesses the Brinell method discriminates more delicately.

When the several conditions which have to be reckoned with, however, are considered, such as: (1) The condition of the surface; (2) errors in measurement, which often approach 75 Brinell numbers on the same piece, carefully and uni-

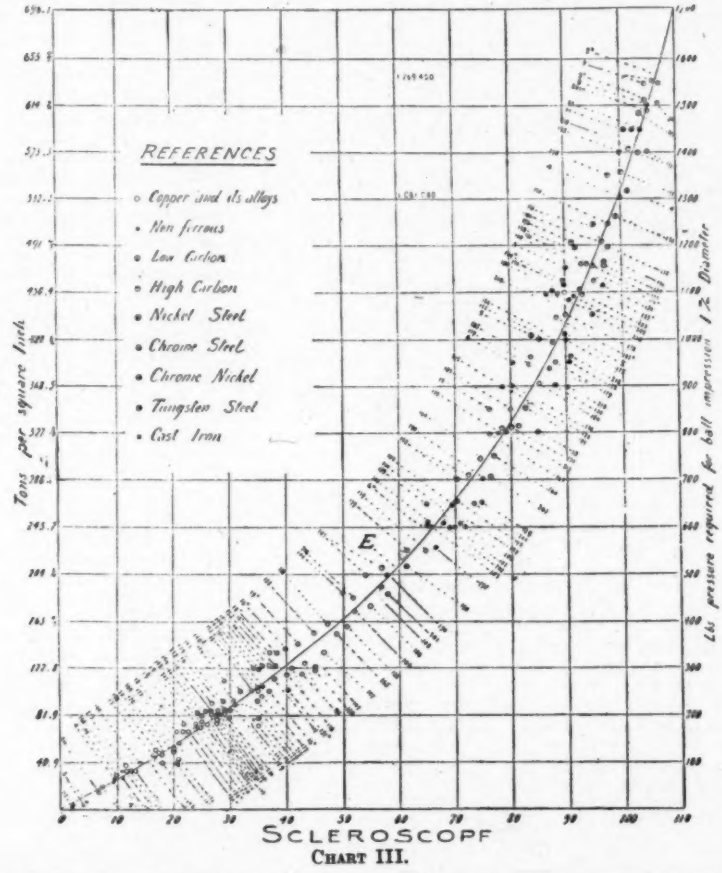



CHART III.

formly hardened; (3) the time allowable in commercial practice, and (4) the rapid fatigue of the operator, it will be seen that the scleroscope, which regularly uses a diamond, will, after all, discriminate the closest on hard steel.

An advantage of this instrument is that dozens of tests can be made and averaged up on the same sample, agreeing within 2 or 3 deg. of each other.

*The Scleroscope Provided with a Brinell Scale.*—Reference to the charts will show that it is a very simple matter to provide the scleroscope with a corrected Brinell scale as per curve B, B′, D, D′, or the constant depth variable pressure curve E Chart III.

Sir Robert Hadfield's suggestion that the scleroscope may perhaps be used for indicating the hardness with closer discrimination than it had been possible in the past on metals of high hardness was made the subject of an experiment. This consisted of reducing the standard point of the scleroscope, so that where formerly it showed 100 on quenched steel of this hardness, it now only showed 75. It was thought that by this arrangement smaller differences of hardness in these hardened steels would be magnified because of the greater striking force or rebound that would be possible by carrying the present 100 mark down further. While it is true that in this way hardnesses greater than is now found in steel can be measured, nothing was gained, and there was no closer discrimination; in fact not so close, for the reason that the haruness degrees were 25 per cent. smaller on the whole scale.

*Influence of Pressure on Ball.*—Several tables of figures given by Sir Robert Hadfield as representing progress made, showing the relation of Brinell using a pressure of 3,000 kg. and that of the standard scleroscope, vary considerably. They also are not in perfect agreement with the results obtained by the author and hereby submitted, using both 3,000 kg. and 750 kg. The study of Chart II. will disclose that a curve resembling that of E, Chart III. (closest), is obtained by the use of a lower pressure. The curve is gradual, consistent, and, in the author's estimation, scientific. It will be noted here that on hardened steels both 500 and 750 kg. have been used. This did not materially influence the results obtained, and if anything the 5,000-kg. readings are closer in agreement to the scleroscope than the 750-kg. ones.

In a specimen of annealed carbon steel (28 hard scleroscope) that we have investigated, we have found the following: E.L. resistance to compression of a cylinder ½ in. in diameter, 75,000 lbs. per sq. in.; tension, 42,000 lbs. per sq. in.; the same steel under a flat punch on its plane surface offers a resistance of 102,000 lbs. per sq. in.—that is to say, this is the point at which it begins to take visible permanent set.

The following are the pressures exerted by the scleroscope and ball tests, the latter using a series of different pressures on the soft metal:

*Scleroscope*, 160,000 lbs. per sq. inch. hardness 28.

*Ball Test* (10 mm. diameter):
500 kg., 170,000 lbs. per sq. inch, hardness 120.
750 kg., 216,000 lbs. per sq. inch, hardness 150.
1000 kg., 231,630 lbs. per sq. inch, hardness 159.
3000 kg., 258,000 lbs. per sq. inch, hardness 170.
4500 kg., 277,000 lbs. per sq. inch, hardness 182.

*Carbon Steel Hardened.*

Scleroscope 943,000 lbs. per sq. inch, hardness 100.
*Ball Test* (10 mm. diameter, using diamond):
750 kg., 995,000 per sq. inch, hardness 680.

### Commentary by Sir Robert Hadfield.

Chart I. shows the statements Mr. Shore puts forward with regard to correlating scleroscope and Brinell tests, the latter carried out under ordinary conditions, *i.e.*, with 3,000 kg. pressure. He shows that there is no very definite relation on these lines, which, of course, is in line with our and other people's experiences. Looking further into the matter, he sees that the trouble lies in the way the Brinell test is usually carried out, that is, using a standard pressure of 3,000 kg., and obtaining a different size of impression for different materials. This is fundamentally wrong, and instead the Brinell method should be so used as to obtain the same size of impression on every material, no matter what the hardness (the pressure required to do this is then the measure of the hardness).

Mr. Shore argues, also, that his scleroscope test does not much exceed the elastic limit of the material, and therefore is a guide more particularly to the elastic limit, whereas the ordinary Brinell test much exceeds the elastic limit, and therefore is more of a guide to the tenacity, so that the scleroscope and ordinary Brinell tests cannot be expected to correlate very closely. By reducing the pressure in the Brinell test so as not to exceed the elastic limit appreciably, better correlation should be expected between the two methods. His arguments are fully justified by Chart III., where he has got a very good relation between the two on a very wide range of materials. Brinell tests are commonly carried out with 3,000 kg. pressure, and therefore Chart I., imperfect as it is, is really the best chart for comparing scleroscope and Brinell.

Chart III. shows how scleroscope and Brinell compare when the Brinell test is carried out on ideal lines. It is to be feared, therefore, that it is, at the moment, only of academic interest, though it makes out a strong case for revising the method of carrying out the Brinell test.

Quite a separate point is the use of a diamond ball. Unfortunately, diamond will not stand more than about 750 kg. pressure, so that it is not a very practical material, but it has enabled Mr. Shore to prove the point definitely that fictitious hardness figures are obtained on hard specimens due to the deformation of the steel ball, which, of course, we have always suspected.

In an appendix to the Paper, Mr. J. J. Thomas (Watertown Arsenal, U.S.A.) deals with the "Relation between the Brinell Ball Test and Scleroscope Readings."

### Discussion.

Professor T. Turner said it might be remembered that at the meeting of the Institute held in 1909 he suggested, in a Paper on tests for hardness, the figure of 6 for converting the Brinell into Shore scleroscope values. It was interesting to notice that Mr. Thomas, in his statement in reference to the relation between Brinell ball test and scleroscope readings, took a figure which was in the neighbourhood of 6, but which varied for different metals, in some cases being as low as 5.25, and in other cases going to over 7. Mr. Shore suggested that his method was intended chiefly to give the elastic limit of the material, while the Brinell test gave an approximation at all events to the tensile tests, or the maximum load. It was obvious that if it was desired to correlate those two properties, it would be well to start with the material in which the maximum stress and the limit of elasticity was the same; a starting point would then be obtained. There

were a number of alloys and some steels which possessed that property. For instance, in the 60 zinc and 40 copper alloy, or in speculum metal, the elastic limit and the tensile strength were identical. Unfortunately it happened, however, that in all those alloys it was impossible to test the hardness by those methods, because if the specimen was put under the Brinell machine it broke; and it was almost as unsatisfactory if the scleroscope was employed. They were unable, therefore, to start at the point which he had suggested would be an ideal one, and they could only get, by a long series of experiments such as Mr. Shore had conducted, a general curve. That curve showed that, as the elastic limit varied from the tensile strength, the value for converting the one test into the other must change. That idea was the fundamental conclusion to be derived from Mr. Shore's Paper. There was no one value which would do for all materials, and the value had to be changed according to the character of the materials dealt with.

Mr. E. H. Saniter said the only point to which he wished to refer was the claim by the author that his method took note mainly of the elastic limit, while the Brinell method took note of the ultimate stress. He tested that point some years ago on two steels of the same ultimate stress with a number of tons difference in the elastic limit, and the Shore scleroscope made no difference whatever between them.

Mr. Cosmo Johns said that the Brinell test was the most useful available for checking the ordinary tensile tests, and would probably continue to be used in its present form for that purpose. It measured tenacity and also probably the yield point, and gave comparative results. It was difficult to say what the Shore scleroscope really measured. It was claimed that it measured the elastic limit, but the values obtained referred to several properties. It was an instrument that, if made the subject of research by a well-trained physicist, would probably give useful results, but it was not an instrument of precision for measuring hardness. Recently two new methods for measuring hardness by indentation, but using a dynamic machine, had been described by Martel, of France, and by Professor Edwards, of Manchester. Professor Edwards' method was most interesting, owing to the striking anomalies found in the case of the metals tin, zinc, cadmium, and to a lesser degree, iron. It was very clear from the divergent results obtained by all these methods that no indentation test measures true hardness, but only some property or properties which, for a limited range, is proportional to hardness. He (Mr. Johns) had suggested in the discussion on Professor Edwards' Paper that if the author—following Kip who had shown some years ago the necessity for using a diamond point when measuring hardness—would use a diamond for his striker and measure, not the energy required to make an indentation, but the maximum energy which *just failed* to produce an indentation, he would probably be able to secure values of the true hardness of the useful metals and alloys. When this information was available it would be possible to discuss, with some hope of success, the results obtained by the various indentation tests, and also to extend the inquiry to those brittle materials whose chief industrial value was their true hardness, but which could not be tested by any indentation method.

Mr. J. S. Primrose, referring to a suggestion put forward by Dr. Stead that some formula to connect the scleroscope value with the Brinell hardness number should be devised, said such a table already existed. Instead of a simple factor being used, it was necessary for different materials not only to use different factors for converting, say, the scleroscope value into the Brinell number, but to that must be added a certain constant, so that the graph representing the conversion, while being a straight line, was not one that passed through the zero point but missed it by a small amount. Such a table had been prepared for a number of steels—plain carbon, nickel, chrome, chrome-vanadium, and also the average—by a very clever experimenter, Mr. R. R. Abbott, whose researches were to be found in the "Proceedings of the American Society for Testing Materials" in the 1915 volume. The table translated the Brinell value into lbs. per sq. in. of tensile strength and the Shore scleroscope figure into tons per sq. in., and also gave the connecting factor with a constant added to it for the Brinell number to be derived from the scleroscope values.

Dr. Hatfield thought the Shore scleroscope, while it might not give values which could be translated into absolute values, did give a more intelligent distinction between different grades of hardness in the higher ranges. With regard to the Shore reflecting the elastic limit, he had made a series of curves and plotted the elastic limit against the Shore, and in one or two instances the curves actually crossed.

Dr. C. H. Desch said it did not seem that people were always quite clear as to what they were attempting to measure. If they were using hardness tests merely as a means of checking tensile tests, well and good, but by hardness he rather understood something connected with resistance to cutting, and there was the very important question of determining what would be the machining quality of material, the property which, in the ordinary use of language, was most closely connected with hardness. None of the papers that had been contributed of late contained any attempt to correlate the machining qualities of the metal with either the Brinell or the scleroscope hardness. He had not many data on the subject connected with steel, but with regard to non-ferrous metals, brasses particularly, he had made a large number of experiments, and certainly there there was no relation between the machining quality and either the Brinell figure or the scleroscope figure. So that if hardness was regarded as really resistance to penetration—for instance, by a tool—then it was not possible to use either the Brinell or the scleroscope method for determining it.

Mr. Hayes said he had conducted experiments with non-ferrous metals, such as 70 : 30 brass, which had been consistently deformed by cold-rolling until there was a drop in its elastic limit of almost 8 to 9 tons per sq. in., the scleroscope numbers dropping 5 to 6 as soon as the limit of plastic deformation was reached by static tests.

Sir Robert Hadfield said it was impossible in these days to get on without measuring hardness. When one heard of comparisons being made with regard to various steels of a ball hardness of 200, 250 or 300, it was remarkable how much information these ball numbers conveyed to one's mind. Combined with analysis they seemed to sum up not only the tensile and elastic limit, but the general qualities of the steel. For that reason he thought it was desirable that special attention should be paid to the subject, as doing away with the taking of tensile tests, and he took the liberty of offering a prize to the Institution of Mechanical Engineers, and any member of the Iron and Steel Institute was quite open to compete for it. There had been already very useful suggestions and out of the offer had arisen very admirable work, which had been presented the previous day to the Institute of Metals by Dr. Edwards. With regard to Dr. Desch's remarks, he did not think of using Brinell ball hardness as a means of checking tenacity, which was quite another quality altogether. With regard to defining hardness, he appealed to the greatest expert in this country, Dr. Unwin, who admitted that it was almost impossible to define what hardness really was. One suggestion that had been thrown out he thought excellent, and that was whether it would be desirable to hold a symposium on the subject. As the President of the Faraday Society, he might say that Society would warmly welcome such a proposal. They did not wish to interfere with the prerogatives and work of other Societies, but if it were thought desirable to hold a symposium he need hardly say that they would give it their cordial support

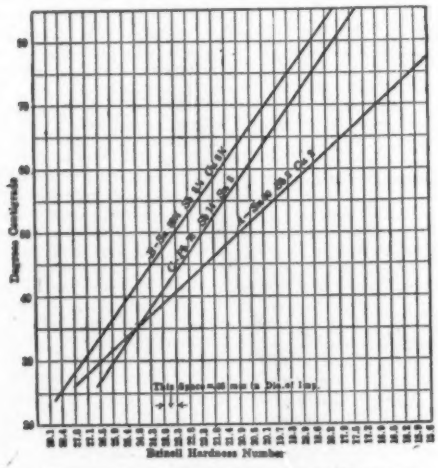
# Babbitt Metal and Babbitted Bearings.

Mr. Jesse L. Jones, Metallurgist of the Westinghouse Electric & Manufacturing Company, at Pittsburgh, in a Paper just presented to the American Institute of Mining Engineers, publishes the result of some Brinell tests made at progressively increasing temperature for a representative lead-base babbitt and a representative tin-base babbitt, showing that the former has superior resistance to deformation at the working temperatures of bearings. Small squares of bearing bronze, tinned and then babbitted with a representative lead-base babbitt and a representative tin-base babbitt respectively were subjected to compressive loading. The lead-base metal showed less average compression than the tin-base metal.

Bearings fail because of wiping, or deformation. Hence tenacity is desirable in a bearing metal, especially tenacity at high temperatures. Disks, 4 in. in diameter and 1.5 in. thick, were made of the metals to be studied, designated A, B, C. They were poured into metal moulds, pyrometer leads being soldered in the centre of each disk. The composition of the metals was as follows:—

| | A. | B. | C. |
|---|---|---|---|
| Antimony ... ... | 8 | 8½ | 14 |
| Copper ... ... ... | 2 | 8½ | nil |
| Lead ... ... ... | nil | nil | 78 |
| Tin ... ... ... | 90 | 83½ | 8 |

The disks were heated by an electric hot plate, the heating being controlled by suitable rheostats. The thermocouple leads were connected with a potentiometer. The disks were well insulated to prevent radiation losses, and after the desired temperature was reached it was held for several minutes to guard against variations. The Brinell hardness tests were made on the bottom surfaces of the disks, a light machining cut being taken from each sample in order to secure a perfectly plane and smooth surface. The Brinell hardness tests are shown in the annexed diagram with the Brinell hardness numbers for abscissæ and degrees C. for ordinates.




Hardness of Three Babbitts at Varying Temperatures.

Complete results from the various testing departments of the Westinghouse company, covering a number of years and a great variety of motors, confirm the superiority of the lead-base metal. The number of wiped bearings that had to be re-lined was about 100 per month with the A metal, but not more than six per month when the C metal was used. These results have led to the adoption of the C metal for all classes of machines, and the complete elimination of A or tin-base metal. Both experimentally and practically the lead-base metal has shown greater resistance to wiping or deformation at working temperatures than the tin-base metal. The hard B metal, while not regularly used, has been found very serviceable in step bearings and other situations where the bearing pressures have been rather high. While the Brinell hardness for the A and C metals is not far from the average hardness found for these alloys when using the standard hardness test piece, the hardness observed for the B metal is much below normal. The reason for the low Brinell hardness of this metal is probably the fact that it is difficult to prevent the large amount of copper in this alloy from segregating, even when it is kept very hot and stirred continuously. The B formula is almost the same as the "genuine babbitt" of the Society of Automobile Engineers of America. It is also similar to the alloy known as Fahrig metal, much used for lining aeroplane bearings.

As it is the common belief among mechanical engineers that the addition of even a small amount of lead to a bearing metal renders it inferior, similar tests to those described above were run on the A metal, with 1, 3, and 5 per cent. of lead added. The addition of 1 per cent. of lead made a decided improvement in its resistance to deformation at increasing temperatures. Additions of more than 1 per cent. of lead increased the hardness, but not in the same ratio. The results of these tests when plotted in a diagram similar to that for the A, B, and C metals, are in harmony with the observations frequently made by users of bearing metals, that when a small amount of lead has been added accidentally to a tin-base metal, its hardness and anti-frictional qualities have been much improved.

After a babbitted bearing has been bored out nearly to size, it is to be next scraped until an accurate fit is obtained. This is a tedious operation and demands a skilled mechanic; hence reaming or broaching are often used instead. A reamer can be passed through a number of bearings in series, so that they will all be lined up in one operation. Reaming, at its best, however, is a rather violent operation, especially after the reamer becomes dull. Broaches are pushed through the bearing by a hydraulic press until the required dimensions are reached. In the case of large bearings, peening or compressing the babbitt by hammering is often specified. The last two operations, in particular, are supposed to compress the babbitt in a bearing and harden it so as to give better service. The following experiment was made to ascertain the effect of compression on the Brinell hardness of babbitt:—Two phosphor-bronze plates (Cu, 80; Sn, 10; Pb, 10; P, 0.5 per cent.), 2 in. square by ½ in. thick, were machined all over; one face was then tinned and babbitted with ¼ in. of babbitt, B metal being used on one sample and C metal on the other. The babbitt was machined to ¼ in. and the samples subjected to a compressive test ranging from 8,500 to 13,000 lbs. per sq. in. in an apparatus so designed that the load would be distributed as uniformly as possible. The Brinell number for B metal remained the same (33.6) for all compressions, while the number for the C metal was 23.8 for 8,500 and 10,000 lbs., and 24.8 for 11,000, 12,000 and 13,000 lbs. per sq. in. The lead-base metal withstood compression better than the tin-base metal. When the load was increased to 30,000 lbs. per square inch, however, the latter presented the better appearance, as the metal had flowed uniformly in all directions over the edge of the bronze plate,

while the lead-base metal compressed more on one side than on the other, and the sample tilted in spite of the rocker base device adopted in the apparatus. At a load of 30,000 lbs. per square inch, the bronze also flowed appreciably. The tests show that broaching, peening, etc., do not appreciably increase the hardness of babbitt, and that hardness must be obtained by quick cooling of the lining by water-cooled mandrels, etc. Microscopic examination of a lead-base babbitt discloses a matrix or groundmass of several eutectics in which are embedded hard cubical crystals of tin antimonide. These crystals, being relatively low in specific gravity, tend to be more numerous in the upper portion of a babbitt lining. This lack of uniformity is guarded against by pouring a thin lining and chilling quickly. The secret of obtaining good bearings consists in keeping this matrix tough and hard.

As the Brinell hardness of babbitt after compression showed practically no change, it was concluded that the various methods of finishing babbitted bearings, such as peening (stretching by hammering or rolling), broaching, and reaming, did not improve the hardness of the metal; and as after these operations and the final scraping, it was still found necessary to make a test run of bearings until the shaft was seated, it seemed advisable to introduce improvements in the usual method of procedure. The so-called glass-like surface of old bearings is considered very desirable. Even if the babbitt is no harder than when cast, all inequalities of the surface have been smoothed out and friction has been reduced to a minimum. It occurred to the writer that, by a rolling or burnishing operation, this desirable finish could be given to babbitt linings so that a machine could be operated at full speed as soon as finished, without any trial run.

A tool designed by Mr. I. Mills seems capable of doing this work satisfactorily. It was made for securing a better seat for the ball-bearing races of a small wireless generator. A variation of 0.0007 in. was found in the bearings, which could not be corrected by reaming or machining. With this tool, the seats in the aluminium alloy end brackets can be rolled to suit the individual variations of the ball bearings. A girl does the rolling, and the bearings can then be inserted or removed with the fingers. If the work is done by reaming, bearings may fit tightly at first, and after having been taken out may become quite loose, because burrs, etc., have been removed. While the Mills micrometer roller has been made only in a very small size as yet, it can be made in larger sizes and would then be capable of exerting much greater pressures. It resembles a dudgeon roller tube expander and consists of a nest of 10 parallel rolls, in a circle,, which can be expanded by a micrometer screw through the medium of two tapered cylinders which give a parallel outward movement to the rolls. The essential feature of the instrument is that the rolls are not spaced equally, as this would cause them to flute the rolled surface.

## Fuel Economy in the Annealing Furnace.

During the past few years there is perhaps no form of apparatus in which such revolutionary changes have been made as in the design of heat-treatment furnaces. On the whole, it is in the gas-fired furnace that the greatest change has taken place. Indeed, the modern gas-fired furnace has few if any features in common with its prototype of pre-war days. Its construction has been simplified and its operation brought within the capacity of the semi-skilled labourer. Its economy and efficiency leave little to be desired, whilst the maintenance costs have been reduced to the narrowest possible limits.

With hard-fuel furnaces the changes have not been so drastic, perhaps because there was not so much room for change and improvement of a radical nature, as the design of this furnace has been evolved over a long period of years. The modifications which have been recently effected have therefore for the most part resulted in an indirect rather than a direct economy, by simplifying the operation, reducing the time required to obtain the desired temperature, ensuring a more uniform temperature throughout the chamber, and by a more robust form of construction considerably extending the useful life of the furnace.

Whilst the gas-fired furnace has been very widely adopted, it has not and probably never will wholly displace the hard-fuel furnace, which for many forms of heat-treatment is still preferred.

On a recent visit to a South Wales works our representative had an opportunity of inspecting a battery of eight coal-fired furnaces with chambers 12 ft. by 5 ft., which are in service for heating and annealing metal blanks during the various processes of manufacture. It is claimed that these furnaces give better and more economical results than was possible with gas-fired furnaces, and the assertion was also made that the heat with the coal-fired furnace is more soaking.

The furnaces were built by Messrs. Curran Brothers, Hurman Street, Cardiff. This type of furnace has already become fairly well-known; the installation in question, however, embodies an important modification. The products of combustion, instead of passing direct from the furnace chamber to the waste flue, are led over the furnace chamber down vertical passages at the back end, and thence through longitudinal chambers beneath the furnace floor to the front of the furnace through similar chambers to the back, and again through a third series of chambers to the waste-heat flue which is placed at the front of the furnace chamber. Practically the whole of the sensible heat is absorbed in the first series of chambers, and is thus given up to the furnace floor by radiation; the little heat remaining in the gases passing into the third series of chambers is absorbed by the walls of the first series.

The fuel consumption, for a temperature of 750 deg., is approximately 11 cwts. per 24 hours. It is, however, more usefully interesting to consider efficiency and economy over a reasonable period under ordinary every-day conditions, which in the case under notice we are able to do. Thus 2,540 heats were taken out of the furnaces with an expenditure of 2,024 cwts. of coal. The coal consumption includes banking down for 24 hours at the week ends and picking up. The weight of metal per heat ranged from 25 cwts. to 30 cwts., and the pans from 18 cwts. to 1 ton.

**UNDERBURNT LIME IN BASIC BESSEMER PROCESS.**—Herr Max Backheuer, in a recent issue of "Stahl und Eisen," discusses the influence of insufficiently burnt lime on the quality and cost of making basic Bessemer steel. He summarises his conclusions as follows:—(1) Imperfectly burnt lime increases the quantity of manganese to be used. (2) The metal in the mixer in such a case is liable to show great variations in its manganese content. (3) Increased losses in the converter and more troublesome working. (4) Increases in quantity of scrapped material, including faulty ingots.

# Zirconia—Its Possibilities in Metallurgy.

At a recent meeting of the Birmingham Metallurgical Society a Paper was given by Mr. Leopold Bradford on "Zirconia—Its Possibilities in Metallurgy."

Mr. Bradford said that the literature of zirconium and the compounds was at present rather limited. Whilst comparatively little practical investigation had been undertaken in England thus far—and that chiefly from the aspect of the ceramic experts—the industrial possibilities of zirconia had been foreseen, and to a considerable extent utilised in America, Germany and Austria. Dr. Harker was credited with being the first in this country to draw attention to the value of zirconia as a refractory of the first order. The extended use of the electric furnace had brought into prominence the need for suitable refractories. Whilst zirconia, in the purest condition, had probably the highest melting point of any metallic oxide at present known, and was also non-volatile below its melting point, a great amount of practical research was necessary before it was safe to predict that it would be found the ideal refractory. Its tendency to form carbides at high temperatures, under certain conditions, as Dr. Rosenhain had pointed out, might detract somewhat from its value, though these carbides were themselves highly refractory. Further, no definite results were yet to hand as to the power of resistance to crushing stress of zirconia bricks at high temperature.

Zirconia, or zirconium-dioxide, was first isolated by Klaproth in 1789 from the mineral zircon; he also discovered its presence six months later in the hyacinth of Ceylon. Both these minerals, however, were silicates of zirconium. Zirconia-bearing minerals were fairly widely distributed, being found in Ceylon, North and South America, the Urals, Norway and Australia, and in smaller degree in the monazite sands of India. Some were of no commercial value, whilst the principal of those possessing industrial possibilities were baddeleyite and zirkite, native oxides bearing from 72 per cent. to 80 per cent. zirconia. Baddeleyite had a $ZrO_2$ content varying between 74 per cent. and 92 per cent., averaging 83 per cent., whilst in some instances pebbles of 98 per cent. value had been found. It occurred in various forms, the most usual being broken stony fragments, pebbles, and blackish glassy masses. The characteristics of baddeleyite and zirkite were (1) high degree of infusibility, (2) high resistance to acid and basic slags, (3) low thermal conductivity, and (4) low co-efficient of expansion. Analysis of baddeleyite showed that it was an oxide mixed with siliceous gangue, or a mixture largely of oxide with a small quantity of silicate.

Zirconia had several features in common with silica and alumina, but a study of the salts which it formed with potassium and chlorine showed that it was more closely allied to titania. It was a non-conductor of electricity, unless heated to a high temperature, when it became conductive. Strongly ignited zirconia was very stable to acids and alkalis. Though pure zirconia alone when moulded for the production of refractory articles such as crucibles were apt to crack and crumble, even though heated up gradually, these drawbacks could be overcome. One of several methods of overcoming them was fusing the oxide in the electric arc furnace. Fused zirconia had a high thermal endurance, and was not affected when heated to redness and plunged into cold water, as its co-efficient of expansion—0.00000084—was extremely low, near to that of quartz glass. Its resistance to crushing stress was many times greater than that of quartz glass. Fused zirconia, therefore, appeared to be a refractory of exceptional value. Its hardness was between that of corundum and that of quartz. It had a specific gravity of 5.89 and a porosity below 1 per cent. The melting point, as recently determined by Podszus, was 2,950 deg. C., but 0.5 per cent. impurity reduced this by 100 deg. In a crucible of fused zirconia platinum could be melted to a mobile liquid. Earlier experimenters had tried the addition of magnesia, with phosphoric acid as binder, and such crucibles had been marketed in Germany, and were said to withstand the action of alkalies. Apparently the high percentage of magnesia would be detrimental at the higher temperature ranges on account of the slight tendency magnesia had to vapourise at high temperatures. The separation of zirconia in a relatively pure state from the native oxide was effected in several ways, and patents had been granted for various methods. He himself had suggested a method consisting of five processes, the first of which would be the fusion of the finely powdered ore with nitre cake.

As to the uses of zirconia, Dr. Rosenhain, reporting on his researches on zirconia at the National Physical Laboratory, spoke highly of it as a special refractory, and indicated a wide sphere of usefulness for it in the future, especially in the purified condition. Dr. Rosenhain's work was carried out on a rather low grade ore testing 74.72 per cent. $ZrO_2$, but he found that even this resisted a temperature well above 1,650 deg. C. for a relatively short period. Actual practical furnace trials over a period of weeks was necessary to determine whether deterioration of lining occurred rapidly or not. Dr. Rosenhain observed that by bonding with a little refractory clay, such as china clay, and making into bricks, which should be burnt well above the actual required working temperature, promising results were likely to accrue. Attention was drawn by Dr. Rosenhain to the considerable shrinkage, appearing to increase with further increments of temperature, which rendered it imperative that the bricks should be initially "dead burnt," or, preferably, electrically shrunk or sintered to prevent disintegration, and further mentioned the tendency of zirconia to form carbides. Dr. Rosenhain did not think the latter likely to occur with a well-made brick in the atmosphere of an open-hearth steel furnace, but thought that under extreme reducing conditions it might occur. The refractory properties of zirconia, as Dr. Rosenhain pointed out, could be enormously increased by purification.

The refractory brick industry appeared to be at present the more important application of zirconia. The cost of such bricks might be reduced by using a body of less refractory material, as bauxite or fireclay, and facing with an outer coating of zirconia. This method has been patented in the United States by McKnight and Youngman, and a similar method by Herzfeld, of Berlin. Herzfeld coated the brick consisting of the lesser refractory with a mixture of similar body and zirconia, and finally with zirconia itself, the whole being carefully fired. This method was applied not only to bricks, but

also to other articles. A raw zirconia lining was initially more costly than one of magnesite brick, but the cost was offset by its greater refractoriness, resistance to corrosive slags, metallic oxides, and the action of molten metal, together with low thermal conductivity and low coefficient of expansion. Actual tests made on a Siemens-Martin furnace in a steelworks at Remscheid, using a zirconia-lined hearth, showed that after four months' continuous working the hearth was still in good condition, and would serve at least another four months before renewal. Careful statistics showed a saving of about 50 per cent. in actual maintenance costs, as compared with an ordinary firebrick lining, apart from increased production and higher efficiency. Engel, of Berlin, in a U.S. patent, April 20, 1915, used 1 per cent. to 10 per cent zirconia mixed with fireclay to manufacture muffles for the distillation of zinc.

Dealing with the metal zirconium and some of the known zirconium alloys, Mr. Bradford said that metallic zirconium was first prepared by Berzelius in 1824 by the reduction of zirconia with potassium, but was by no means pure. In all cases the metal was extremely difficult to obtain in a pure condition on account of its ready tendency to combine with oxygen, nitrogen, silicon, iron and carbon. By reducing potassium zircono-fluoride with aluminium at about 1,500 deg. C. a pure metal (98 per cent.) was formed, but if the reduction was carried out in the electric furnace the two metals united to form an alloy. Reduction of the double fluoride with magnesium in the electric arc furnace gave a 94 per cent. metal. Better results had been obtained by reduction of the double fluoride with sodium in the presence of sodium chloride in a sealed iron bomb. This gave 97 per cent. to 98 per cent. zirconium, and produced an amorphous type of metal. Wedekind's method was to press the 97-98 per cent. amorphous variety into rods, and use them as the terminals of an electric arc operating in hydrogen under reduced pressure. Fusion took place, and a pure metal of 99.8 per cent. resulted. This resembled white cast-iron, had a hardness of 7.8 (Mohs' scale), a specific gravity 6.40 at 18 deg. C., specific heat 0.0804 and heat of combination 1,958 calories with a melting point of 1,530 deg. C. Amorphous zirconium was a bad conductor of electricity, and was readily oxidised, whereas the crystalline variety was only oxydised to $ZrO_2$ at a white heat. It was not affected by strong mineral acids. Kuzel and Wedekind also produced a metal by heating zirconia with calcium in a finely divided state, giving 99 per cent. zirconium. A later method, due to Podszus, was to heat potassium zircono-fluoride with sodium in a steel bomb. The metal thus obtained was in a finely divided crystalline condition, of about 99.3 per cent. purity. It would thus be seen that the metal had been obtained in the amorphous graphitoidal and crystalline states. The latest atomic weight deduced for zirconium was 90.6. An interesting summary by Wedekind and Lewis of researches into the mechanism of the constitution of zirconium produced under varying conditions and by diverse methods would be found in the Journal of the Society of Chemical Industry for 1910-11.

The use of the metal zirconium so far had been principally in the direction of producing various alloys, some of which were credited with special functions and advantages. One of these alloys contained 60 to 90 per cent. zirconium, the rest being mainly iron. It was substantially free from metalloids and oxides, and was malleable and ductile. A self-hardening alloy for cutting tools consisted mainly of nickel, or nickel and cobalt, together with 2 per cent. to 40 per cent. zirconium, and an amount of chromium not exceeding 35 per cent. Schirmeister, in his study of the aluminium alloys, mentioned one containing up to 5 per cent. zirconium, which, like the aluminium-titanium alloys, was easily rolled. According to experiments carried out at the Central Bureau of Research, Neubabelsberg, it was found that zirconium alloyed with aluminium behaved practically the same as the aluminium-titanium alloys, being easily produced, but requiring higher temperature for production than the latter. Resistance to tensile stress and hardness were rather lower than in the case of the Al-Ti series, and the amount of elongation correspondingly higher. An alloy of 6 per cent. zirconium exhibited maximum capacity of resistance to tensile stress, the value being 12½ kilos. per sq. mm. (8 tons per sq. in.). Nickel-zirconium alloys were also in use. Alloys of zirconium with tungsten, molybdenum and tantalum were the subject of a Paper issued to Podszus, who reduced the mixed oxides by means of a current of ammonia gas in an electrically heated furnace, at a temperature at which the nitrides dissociated, followed by a rapid cooling to inhibit the re-formation of the nitrides. Pure alloys, in compact form, were said to be produced by this process. Ferro-zirconium, prepared by reducing zirconia with aluminium powder by the Goldschmidt process, could be easily produced, and was the most common, as it would doubtless prove the most important of zirconium alloys. It could be made to contain up to 35 per cent. zirconium, and had been used to some extent recently to replace ferro-titanium in the purification of steels. The addition of small quantities of this alloy to steel, brass and copper was said to secure sound castings and considerable resistance to acids in the metals to which it was applied, and also to increased tensile strength. Its action was probably that of a " scavenger " in the removal of oxygen and nitrogen. One of the recent ferro-zirconium alloys placed on the market in America contained 40 per cent. to 90 per cent. of zirconium. Small percentages of titanium and aluminium were sometimes introduced. One of such alloys patented in the United States showed a composition of zirconium, 65 per cent; iron, 26 per cent.; aluminium, 7.7 per cent.; titanium, 0.12 per cent. This was claimed to be highly resistant to chemical reagents, and not subject to oxidation. An English patent (29,376 of 1910) described a ferro-zirconium alloy containing 20 per cent. zirconium, which was claimed to be a scavenger, and was used in amount equal to 1 per cent. of the steel treated. Finally, it was recorded from private and unofficial sources that ferro-zirconium had been employed very successfully in Germany in the manufacture of zirconium steel for armour plates, armour-piercing projectiles, bullet-proof shields, etc. The distinguishing feature was its extreme hardness. Careful tests made in Germany showed a 1 in. thick armour plate of this steel to be equivalent in all respects to a 3-in. armour plate of best German steel.

---

In the list of prohibited exports the following heading has been deleted :—(A) Castings, malleable, hematite iron, the following cycle fittings. Appended are new headings :—(A) Antimony and alloys of antimony; (B) coal-tar pitch; (C) pitch (other than coal-tar pitch) and all its mixtures and preparations.

# The Boronic Deoxidising of Copper.

By James Scott.

As it is impossible to directly follow out the procedure of boronic compounds when they are exercising their influence in copper and its alloys, the observer is compelled to resort to experimental tests. Moreover, these substances, by deoxidising the treated metals, are intended to clear it of all undesirable matter, wherefore an analysis, or microscopical examination, of the finished copper, brass, or bronze itself will not disclose the incidental effects for which we are searching.

Boron, some readers may need reminding, is an element existing in two forms, one of which is minutely crystalline and dark grey or almost black, while the other is an amorphous green-brown powder. Strong heat gradually converts boron into boric anhydride (boron trioxide) and this, when sufficiently hydrated, becomes common boric (or boracic) acid.

It is evident that the deoxidising property of boron compounds depends for its efficiency on the boron itself, and not on the companion element; and boron only oxidises under the action of very high temperatures. As the free boron is thus converted into trioxide, the cleansing of copper, etc., must be due to the formation of this anhydride, sub-acid, or its sub-oxides—whichever term one prefers to use.

It is believed no sub-oxides of boron exist; but although they may be difficult to isolate, there can be no reason to doubt that they do occur. In heating boron in a suitable flame, it *gradually* changes from its green-brown colour to white. The intermediate tones must indicate the presence of sub-oxides, since only pure white denotes the trioxide.

According to the actual experience of a well-known founder boron copper has very high qualities as a deoxidiser and flux. He had to fall back, in an emergency (where cartridge gilding, an alloy of 95 per cent. copper and 5 per cent. zinc, was required), on the use of some scrap from sheet copper rolled to 1/3,000ths inch to 1/5,000ths inch. In the first melt with borax, charcoal, and salt the resultant metal was very porous and dirty. Another melt was tried with the addition of 1 per cent. boron copper, which was placed in the bottom of the crucible, with the scrap, of course, above it. When the copper began to melt, a couple of handsful of salt were thrown in, and charcoal added during the completely molten condition. The spelter was put in just before the charcoal. In this case excellent, clean, and sound bars were obtained, rolled to ½in. before being annealed, after which a selected number were rolled to 1-16in., again annealed, and finally rolled to .018in. No cracks or defects of any kind were discernible by the closest scrutiny.

A boron compound could not perform chemical, or true, deoxidation until it became decomposed into its elements, since it is the boron itself which takes up the oxygen. Deoxidation otherwise effected would simply mean a clearance from the melt of intact, although minute, particles of actual cuprous oxide, and these would represent a metallic loss. The more highly coloured a slag is with blood-red in particular circumstances, the greater the loss of metal, because it is the metallic oxide which imparts this tint.

Boron, in oxidising to boric acid—or we will say sub-acid—reduces any metallic oxide in the melt to metal, because it takes up the oxygen itself.

Copper oxides, definable by chemical terms, are of two kinds, the cuprous ($Cu_2O$) and the cupric (CuO). The first-named is brown-red and the second black. But there are many lower oxides which can only be referred to by their colours, these being crimson, violet, blue, and grey.

Even in nominally good copper, after it has been in use for a short time, the microscope will reveal scattered globules or patches of these tints upon the surface; yet the general colour, judged by the naked eye alone, still appears wholly salmon-pink.

In seeking for the reason why boron compounds possess so remarkable a merit, we must note the affinities which the various reagents used for the

FIG. 1.—VIEW OF BORON-COPPER (ABOUT 1-30 IN. WIDE) SHOWING OCCLUDED GLOBULES OF BORON FLUORIDE IN GROUPS BENEATH AND BETWEEN THE GRANULES OF METAL. THE TENDENCY TO CONCENTRIC ARRANGEMENT IS EVIDENT.

FIG. 2.—ABOUT 1-30 IN. OF A TYPICAL PORTION OF SURFACE OF BORON-COPPER, SHOWING THE CONCENTRIC OR RIPPLED BLISTERS DUE TO PRESENCE OF OCCLUDED BORON FLUORIDE; MAGNIFIED.

purpose of deoxidising and fluxing display for oxygen, since that gas is the chief one from which copper and its alloys suffer by combination.

With charcoal the oxygen forms carbon monoxide and carbon dioxide, gases that are not reducible to their elements under ordinary conditions.

When salt—chlorine and sodium—is split up the latter element is capable of taking up oxygen and becoming sodium oxide; but it must be generally fused only in metallurgical work, and act solely in a mechanical manner in eliminating oxidised particles.

Borax—boric acid and sodium—yield practically two potential deoxidisers, the former only of which can possibly serve as such in connection with molten copper.

Even when boric acid—or boric sub-acid—is heated to redness it does not volatilise, so that when once the boron has removed the oxygen from a melt it cannot be reverted back again. The distinction between *attracting* and *combining* with oxygen—as boron does in changing to trioxide—and simply *dissolving* copper oxide and thus removing copper with oxygen, as does borax, should be noted.

The modern boron-copper pellets, now so largely used in the foundry, contain occluded globules of boron fluoride, a gas. When this deoxidiser is added in proper quantity to melting copper the globules are freed, and cause satisfactory ebullition, attracting oxygen as explained elsewhere.

Fluorine is a pale yellow gas, obtainable in the free state only with the greatest difficulty. In combination with boron it forms boron fluoride,

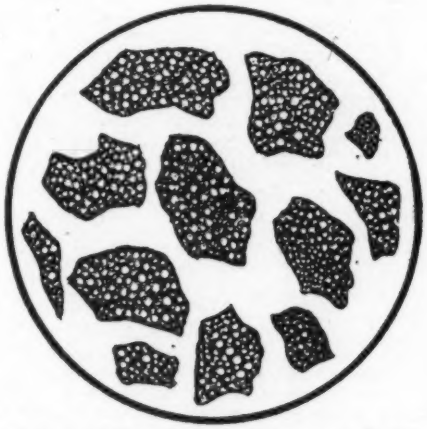


FIG. 3.—ABOUT 1-30 IN. SPACE, MAGNIFIED, CONTAINING PARTICLES OF COPPER OXIDE SHAKEN FROM BORON-COPPER HEATED OPENLY. THE MINUTE SPECKS PROBABLY INDICATE INCIPIENT BORIC TRIOXIDE.

which (as already stated) is incorporated in boron copper. Now fluorine has no affinity for oxygen, and all attempts to combine the two elements have failed. Therefore fluorine cannot act as a deoxidiser; hence the boron must do so; and thus the boron fluoride could not be made to serve its purpose unless it is decomposed into fluorine and boron. The former combines, with inflammation, with carbon, and may account for many of the yellow sparks noticed when boronised copper is being melted.

Copper which has been treated with boron copper can be remelted several times without additional boron. I think that this fact implies that some ultra-microscopic particles of boric acid—the anhydride or trioxide—remain uniformly scattered in the metal, and serve as sufficient deoxidisers in such instances. This must be the case when molten copper is poured before the agitation due to the presence of boron fluoride is completely finished.

At the same time it must be borne in mind that boron is capable of combining with metals to form hard, refractory borides, magnesium boride being easily obtainable. But so far as I am aware, copper-boride has not been isolated or indisputably recognised.

In Fig. 1 is shown a typical specimen of boronised copper, in which the surface globules are very plain, held beneath pellicles which appear to consist of boron anhydride. They were very striking in the crevices between the granules.

Most of the granules are elegantly distorted, as shown in Fig. 2, and it is evident that during the preparation of the boron copper the globules of boron fluoride separate out during the cooling, in cases where they do not fully reach the surface, cause the solidifying granules to wave or ripple, and these patterns are retained by the hardened substance.

The writer has heated some of the boron copper pellets in a ladle until they were covered with films of cuprous and cupric oxide, which were allowed to form so that the gas globules could be decomposed. Upon cooling the material and shaking it up in a glass jar, the minute flakes of metallic oxide were dislodged, and when selections of them were magnified many disclosed clusters of exceptionally minute brown-white and white specks of the kind shown in Fig 3, these almost certainly representing boric trioxide or sub-acid. Such minute particles of deoxidiser would scatter uniformly in a molten metal, and be productive of effective purification.

It must be understood that this result was intentionally aimed at. The boron could not prevent oxidation because fluidity was not allowed. In *molten* copper the minute invisible globules of boron fluoride are constantly swirling to and fro, and passing upwards, freeing their boron in infinitesimally minute dimensions, thereby enabling it to seize upon the available roving oxygen, which it undoubtedly picks up more readily than it does when exposed to oxygen in a blowpipe flame.

## Piston Rings, Limited

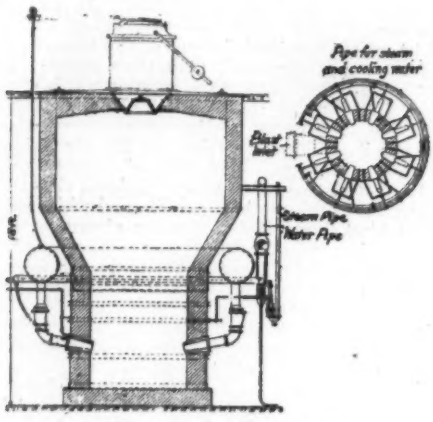
At the Birmingham County Court, on October 17, Mr. Hurst, on behalf of the Ministry of Munitions, applied for a compulsory winding-up order respecting Piston Rings, Limited, formerly of Branston Street, Birmingham. Counsel said that the debt alleged to be due from the company to the Ministry was extremely large. The Ministry had delivered to the company a large quantity of copper and other metal for the purpose of making munitions of war, but the company had failed to return the equivalent in manufactured articles, and it was maintained that £17,281 was due. In addition, £3,554 was said to be due to the Birmingham Munitions Committee as agents of the Ministry. It transpired that the company had disposed of both of its factories.

Mr. Hurst mentioned that an affidavit had been submitted by the managing director of the company opposing some of the statements of the Ministry, and this was ordered to be filed.

The order asked for was made.

# The Wuerth Gas Producer.

In a recent issue of "Stahl und Eisen" Dr. Markgraf describes a gas producer with auxiliary tuyères for working with steam. The idea of working a producer with air blast and steam combined originated with Ebelmen, who published the results of his experiments between 1841 and 1843. A M. Fichet took up the subject in 1907, and carried out further experiments near Paris. At the same time a M. Sépulchre attacked the problem at Gironcourt, near Nancy, and produced jointly with the French firm Fitchet & Hurtey, the gas producer known by the three initials as the "S.F.H. producer." Finally, the Luxemburg firm of the name Paul Wuerth tried to introduce the S.F.H. producer in Germany, but, after some trials made at Rodingen, it became apparent that German fuels required different treatment, and after some exertions and sundry failures a design was evolved which has now stood the trial of many years at the Zeche Prinz Regent, near Bochum, in Rhenish Westphalia. Several other producers of this modified design are now working or under construction in different places.




WUERTH GAS PRODUCER.

Our illustration shows a vertical section and a sectional plan of a 60-ton Wuerth producer. It will be seen that, like the "dry" producer, it is worked on the blast furnace principle, and consists of a hearth without grating, a bosh, and a shaft. The normal working of this producer is really like that of the "dry" producer referred to, and the sole object of the additional tuyères or nozzles is to blow in steam to assist the descent of the charge. The fuel to be gasified is broken coke and breeze, from 0.4 to 2.4 in. in size, mixed with blast-furnace slag, which is added in small quantities, up to about 12 per cent. Briquettes made of coke breeze with pitch as a binder are said to have also answered well. There are two tapping holes, opposite each other, for drawing off the liquid slag. These holes are plugged with clay and are tapped alternately. With every tapping of slag some iron, a kind of spiegeleisen, containing phosphorus and manganese, is drawn off, which settles down in the shape of small pigs. The slag is granulated, and, for the time being, is dumped. The gas is taken off at the top of the producer by the two branches of the downcomer, and is led to a dust catcher. The horizontal ring of steam nozzles divides the producer into two distinct zones, an upper comparatively cool zone, in which the charge is heated up, and a lower hot zone within which the coke is quickly carbonised and the slag melted. Scaffolds—to use blast-furnace terms—and the consequent formation of hollows are thus avoided. Since the introduction of steam nozzles the Wuerth producers are working most satisfactorily with both hot and cold blast. The author gives specimens from self-registered charts, showing the smooth working of the producer as regards blast pressures, gas temperatures, and carbon dioxide content of the gas produced. Provision was made at the outset to heat the hearth block from below, but this was soon found to be a superfluous refinement. Size for size of shaft diameter, a Wuerth producer will deal with two to three times the quantity of fuel that can be passed through a producer with revolving grate and fed on coal. The rate of driving of the Wuerth can be reduced to about one-half the normal without interfering with its smooth working.

The author publishes an elaborate comparative table of data, covering an entire page of 9 in. by 6 in., relating to the working of a Wuerth producer dealing with 50 tons of coke in twenty-four hours, as compared with a "dry" producer, as described in our earlier issue, dealing with 30 tons of coke in twenty-four hours. We abridge and summarise the contents of this table as follows :—

| Per 24hours. | Wuerth producer. | "Dry produce. |
|---|---|---|
| **Input.** | | |
| Quantity of coke ... ... ... tons | 50 | 30 |
| Carbon content in coke... ... ,, | 43.7 | 26.2 |
| Hydrogen in coke ... ... ,, | 0.25 | 0.15 |
| Slag added ... ... ... ... ,, | 5.5 | 5.3 |
| Quantity of blast... ... cub. ft. | 5,729,880 | 4,022,360 |
| Total water (steam, coke and blast) ... ... ... tons | 19.6 | 2.25 |
| Cooling water ... ... ... ,, | 110.0 | 230.0 |
| **Output.** | | |
| Gas in cub. ft. ... ... ... ... | 7,808,100 | 4,919,350 |
| Total dust ... ... ... ... tons | 4.8 | 0.733 |
| ,, water ... ... ... ... ,, | 6.15 | 1.10 |
| ,, slag ... ... ... ... ,, | 6.65 | 5.4 |
| ,, iron ... ... ... ... ,, | 0.15 | 0.95 |

The author calls special attention to the large quantity of dust produced in the Wuerth. The bulk of this is coarse and is easily trapped in the dust catcher, or readily settles down in the first lengths of the pipe conduit. The finer dust still remaining gives quite a milky tinge to the gas, and has to be removed in a special cleaning plant if the gas is to be used for engines. The coarse dust is composed mainly of unburnt coke dust and particles of slag, the silica contents showing a gradual increase in the dust (21 per cent. in the dust catcher and 64 per cent. at the furnace) where the gas is mixed with gas from an ordinary coal-fed producer. The Wuerth firm intends to add a device to the producer whereby the coarse dust, rich in coke, will be conveyed back to the gas producer and charged into it without any chance of its being carried off again by the outrushing gas. They reckon that this will raise the efficiency of the producer by 4 to 5 per cent. One explanation for the large quantity of dust being carried off in the Wuerth is the high rate of driving in this case, as some 235 cub. ft. of coke are gasified in it

per sq. ft. of hearth area per hour, as against 128 cub. ft. in the " dry " producer. The question whether the quantity of dust is increased by the working with steam has not yet been settled, says the author.

The pig-iron produced contains the following percentages:—Si 3, Mn 2.91, P 1.42, and S 0.07. The analyses of the coke and slag are not given for this producer. In the case of the S.F.H. producer the fuel ash contained 4.26 per cent. of iron, the granulated blast-furnace slag mixed with the input 1.86 per cent., and the other kind of slag charged into the producer 9.98 per cent.

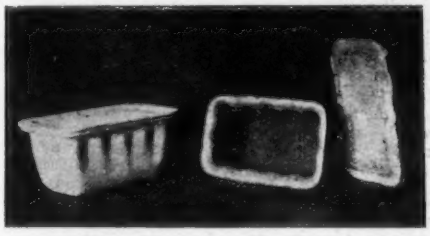
The thermal efficiency of the Wuerth producer is given as 89.3 per cent. (as against 90.4 per cent. of the " dry " producer), including in both cases the " perceptible " heat of gas, steam, and dust (amounting to 15 per cent. in the former case and 19.2 per cent. in the latter case). The losses amounting to 10.7 per cent. in the Wuerth producer are made up of 5.6 per cent. for loss of carbon in dust, 0.9 per cent. heat losses in slag and iron, 1 per cent. in cooling water, and 3.2 per cent. for radiation and balance. The corresponding figures for the " dry " transformer are 1.2 per cent., 1.5 per cent., 3.8 per cent., and 3.1 per cent. respectively.

**DOES COPPER IN STEEL PREVENT CORROSION?**—The familiar topic of copper-bearing steel and the corrosion problem was brought out by a Paper before the American Electrochemical Society, at its recent Pittsburgh meeting, by Mr. O. W. Storey, entitled " The Corrosion of Fence Wire." Attracted by the fact that much of the barb fence wire in certain Western distrits, made years ago, is still in good condition, while wire now made corrodes or wastes away rapidly, Mr. Storey started an investigation as to the cause. Much to his surprise he found that, in fences where one strand had corroded and the one alongside it had not, the analysis revealed in the latter the presence of copper. He exhibited specimens. His conclusions are as under:—It has been definitely established that the durability of old steel fence wire is due to the presence of copper. Manganese does not increase the corrosion of steel and its absence does not decrease the corrosion. The copper in the early steel and wrought irons came from the copper-bearing ores of the eastern United States and imported ores. The proportion of copper-steel made decreased with the increasing importation of the copper-free Lake Superior ores. Steel fence wire containing copper is as durable as wrought iron. Present-day steel fence wire usually does not contain copper, and therefore corrodes rapidly. Under ordinary atmospheric conditions zinc corrodes more slowly under conditions favouring rapid corrosion of iron, and *vice versa*, iron corrodes more slowly under conditions favouring rapid corrosion of zinc. The life of fence wire is dependent upon the quality of both the galvanising and iron or steel base. Since the galvanising is usually thin, the life of the fence depends principally upon the iron or steel base, which should be highly resistant to corrosion. In the course of the discussion which followed, Mr. F. N. Speller, metallurgical engineer of the National Tube Company, advised caution in drawing conclusions regarding this complex problem. He recognised the value of copper in steel as a resister of atmospheric corrosion, but in water pipe a different condition obtains. Mr. D. M. Buck, metallurgist of the American Sheet & Tin Plate Company, Pittsburgh, called attention to the fact that sheet steels all corrode in the first 10 to 12 months, but that the copper-bearing ones in all cases slow up at this point, being covered with an apparently vitreous, dense protective coating, while all others continue to waste away.

## Annealing Pans.

A special form of pressed steel corrugated pan is now being supplied to a number of firms engaged on munition work by Mr. Walter Perry, Lilleshall, near Newport, Salop, which possesses special features and claims a number of advantages over the ordinary type of pan in general use. Of two types in which it is made, No. 1 is specially designed for case-hardening and heat-treating, the inside measurements being 11 in. by 5½ in. by 6 in. deep. No. 2 type is specially designed for slaking and quenching, its inside measurements being 11¼ in. by 6 7-16 in. by 4¾ in. deep.

These pans are pressed out from a solid piece of the best quality of steel boiler plate, and the flange at the top and the corrugations in the sides, ends and bottom successfully prevent the pan from warping and enable it to retain its original shape until the last. The bottom of the pan is slightly raised off the floor of the muffle by means of these corrugations, to ensure even heat all round the exterior surface. Being pressed out of the solid, there are no welded joints to crack and split, and



BEFORE. AFTER.

ANNEALING PAN BEFORE AND AFTER 500 HOURS UNDER FIRE.

the pans are proportionally lighter than those made in cast iron. The covers are dished and also pressed from solid steel plate, and are so designed that they fit firmly on the pan, and enable a perfectly air-tight joint to be made.

The makers state that these pans have been known to last from 200 to 300 hours under fire, their life being influenced according to temperature and local conditions in working. There is one instance on record where the No. 1 type of pan lasted over 500 hours under fire. The durability in this instance was remarkable, as the similarity of conditions and temperature was equal to that obtaining in all coal-fired muffles. The extraordinary length of service in this particular instance can only be accounted for by the fact that the pans were handled by careful workmen each time they were withdrawn from the furnace. Generally speaking, annealing pans are as a rule somewhat roughly handled, and on each occasion when they are withdrawn from the furnace the freshly-formed scale is knocked off, thus exposing a clean surface for re-scaling when next placed under fire. This causes them to deteriorate much more rapidly than they otherwise would.

The annexed figure gives an illustration of this particular pan. The view on the left shows the new pan before service, and the right-hand view shows the pan and lid which actually lasted over 500 hours under fire.

D

## Trade Talk.

MESSRS. IRONSIDE, SON, & COMPANY have removed to 7, Gracechurch Street, London, E.C.3.

THE MILLOM & ASKAM HEMATITE IRON COMPANY, LIMITED, have lighted a furnace at Askam.

THE importation of time-recording instruments of all kinds into the United Kingdom is prohibited.

MR. L. BARLOW, metal broker, St. Margaret's, Eaton Crescent, Swansea, has been adjudged bankrupt.

THE Swedish Trade Office has been opened at 23, Ryder Street, St. James's Street, London, S.W.1.

THE Admiralty propose to start schools in various shipbuilding centres for the training of electric welding operators.

CONSIDERABLE damage has been caused by fire at the engineering works of Messrs. R. G. Garvie & Sons, Canal Road, Aberdeen.

THOS. FIRTH & SONS, LIMITED, are about to make an issue of £600,000 of 5 per cent., tax free, second preference shares of £1 each.

L'ALUMINIUM FRANCAIS, of Paris, have appointed Messrs. O. Murray & Company, 69-70, Mark Lane, London, E.C.3, as their British agents.

THE UNITED STEEL COMPANIES, LIMITED, it is stated, do not intend to make use again of their Lowther Works at Workington for smelting iron.

DUNCAN STEWART & COMPANY, LIMITED, are making considerable extensions to the buildings and plant at their London Road Iron Works, Glasgow.

MR. A. HUDSON, of Woodkirk, and Mr. J. C. Ferguson, of Carlinghow, have acquired the engineering works of Mr. W. Howgate, of Dewsbury.

LAST month a fire broke out in the joinery shop of Messrs. Russell & Company's Kingston Shipbuilding Yard, Port Glasgow. Considerable damage was done.

H.M. THE KING has been graciously pleased to accept the invitation of the office-bearers and council to become the Patron of the Institute of Marine Engineers.

A QUANTITY of surplus machine tools, etc., at the Rudge Works, Coventry, of Rudge-Whitworth, Limited, will be offered for sale by auction on November 7.

MESSRS. A. A. WATERS AND A. H. FARAM, engineers and tool makers, 55, Western Road, Southall, trading as the Waltham Tool Company, have dissolved partnership.

HENRY R. MERTON & COMPANY, LIMITED, are being wound up voluntarily, with Sir Woodburn Kirby, of Bassishaw House, Basinghall Street, London, E.C., as liquidator.

CONSIDERABLE damage has been done by fire at the Albert Works of Easterbrook, Allcard & Company, Limited, engineers' tool manufacturers, Penistone Road, Sheffield.

THE Royal Commission on Decimal Coinage, of which Mr. T. McKenna, chairman of the executive committee of the Decimal Association, is a member, held a preliminary sitting on October 16.

THE B. & S. COMPANY, OF BRISTOL, makers of "Kleensurface" high speed steel protective hardening compound, have decided to establish district agencies directly under their own control.

THE recent gift of Vickers, Limited, of £100 per annum for a "Vickers' scholarship" at the Barrow Technical School, has been followed by a similar gift from the Barrow Hematite Steel Company.

A CONFERENCE on Women in Industry was held under the auspices of the Industrial Reconstruction Council on Tuesday, October 22, in the Hall of the Institute of Journalists, 2 and 4, Tudor Street, E.C.4.

THE partnership heretofore subsisting between Messrs. T. Bradshaw and S. Bradshaw, engineers, Turk Street, Bolton, Lancaster, under the style of the Bolton Motor Wagon Company, has been dissolved.

THE controlling interest in J. Samuel White & Company, Limited, of East Cowes, Isle of Wight, has been acquired by Mr. A. Mitchelson, of the firm of A. Mitchelson & Company, of London, Cardiff and Swansea.

DR. ADDISON, speaking in London last month, said that a demobilisation scheme has been adopted and would shortly be issued. It would secure to those who have served the earliest possible opportunity of employment.

MR. W. CRUDGINGTON, lately carrying on business as Crudgington, Kennedy & Company, iron and steel merchants, at 191, Corporation Street, Birmingham, is paying a first and final dividend of 20s. in the £, with 4 per cent. interest.

AT a meeting of the Birmingham Metallurgical Society, held on October 17 at the Chamber of Commerce, a paper was read by Mr. F. Johnson (Birmingham) and Mr. W. H. A. Robertson (Bedford) on "The Rolling of Metals."

THE first meeting of the autumn session of the Nottingham Society of Engineers was held on October 23, Mr. W. R. Bates (Alfreton) presiding. Mr. G. J. Ward, president, of the Stanton Ironworks Company, Limited, delivered a lecture on "High Temperature Measurements."

AN extensive questionnaire is being issued by the Royal Commission on Decimal Coinage, to a large number of manufacturers and public bodies, for the purpose of ascertaining their views in regard to the proposals contained in Lord Southwark's Bill now before the Upper House.

DUNCAN, STEWART & COMPANY, LIMITED, London Road Iron Works, Glasgow, will shortly have completed a new shop designed for the manufacture of rolling mills, shears, and other iron and steel works machinery. Mr. T. E. Holmes, formerly with Davy Brothers, Limited, Sheffield, is in charge of this new department.

THE announcement was recently made that the Briton Ferry Ironworks were about to change hands. We now understand that the works have been purchased by Baldwins, Limited, at the price of £193,000. The plant comprises two blast furnaces and makes hematite iron. They have been the only independent blast furnaces in West Wales.

AT the meeting of the Birmingham Small Arms Company, Limited, it was stated by the chairman (Sir Hallewell Rogers) that the total savings of the employés of the company and the Daimler Company in War Savings Certificates and savings bank deposits amounted to £500,000, the whole of which had been accumulated in a period of about two years.

THE GENERAL ELECTRIC COMPANY, LIMITED, announce that they have completed the purchase of the works and of the goodwill of the manufacturing business hitherto carried on by Fraser & Chalmers. Practically the whole of the personnel have transferred their services to the G.E.C., who will carry on the business as a going concern and under the title of Fraser & Chalmers Engineering Works.

FREDERICK BRABY & COMPANY, LIMITED, are entirely remodelling the galvanising department at their Eclipse Works, Petershill Road, Glasgow. In fact, the whole of the department is being rebuilt and extended to practically double its present output capacity. When the alterations are completed it will be one of the largest, and certainly one of the most up-to-date, works of the nature in the kingdom.

STEEL CASTINGS, LIMITED, have in progress much-needed additions to their Parkhead (Glasgow) works and plant. These include considerable extensions to the foundry buildings and equipment, the erection of an additional melting furnace, together with producers and accessories, and the rearrangement of the works' sidings so as to facilitate delivery of raw material and despatch of the finished work.

THE following office-bearers were elected at the recent annual meeting of the Derby Society of Engineers:—President, Sir A. Seale Haslam; chairman, Mr. W. Price Abell; committee, Messrs. C. G. Conradi, H. T. H. Edgecombe, G. H. Haslam, H. Matthews, W. H. Swift, and A. Wormald; hon. sec., Mr. R. W. Reid; hon. treasurer, Mr. J. E. Anderson. Following

the business meeting, the new chairman gave an address on "The Future of Young Engineers."

At the quarterly meeting of the Association of Chambers of Commerce of the United Kingdom, held in London last month, the following resolution—"That this Association protests against the suggested elimination of merchants as recommended in the report of the Iron and Steel Trades Committee appointed by the Board of Trade"—proposed by the Newcastle Chamber of Commerce, was supported by the London, Liverpool, Cardiff, Swansea, Birmingham, and Bolton Chambers, and was carried.

Answering General Page Croft in the House of Commons on Oct. 21, Mr. Wardle said no shares in the Mond Nickel Company had been transferred to enemy subjects resident in Germany during the war. Under a reconstruction agreement, entered into before the war—on July 24, 1914—the company had agreed to allow fully-paid shares to shareholders of the previous company, some of whom were enemy subjects on December 3, 1914. All dividends from the outbreak of war had been paid to the Public Trustee. No beneficial interests had passed, or could pass, to an enemy subject as a result of the transaction.

We understand that Mr. Frank E. Pitts, the late manager of the St. Pancras Aluminium Foundry, has severed his connection with that concern, and has now acquired the old-established business of Broad, Salmon, & Company, founders in bronze, aluminium, gun metal, brass, and other non-ferrous alloys. The business has been converted into a limited liability concern under the style of Broad, Salmon, & Company, Limited, with registered offices at 41 and 42, Windmill Street, Tottenham Court Road, London, W.1. Mr. F. E. Pitts is the managing director, the other directors being Mr. R. H. N. Lindley and Mr. F. R. Pool.

A sub-committee of Greenock Corporation has prepared an exhaustive report on negotiations now proceeding with Messrs. Caird & Company (Harland & Wolff) with reference to the purchase of certain properties with the view of shipyard extension. The Corporation properties under consideration are 10 in number, and the present valuation is put at £22,089. It is the opinion of the sub-committee that it would be in the interests of the Corporation to agree to the purchase on the proposed valuation. Within the area to be acquired by the firm there are 916 apartments, of which 85 are owned by the Corporation.

W. S. Laycock, Limited, of Sheffield, have just completed an extension of their works at Millhouses in the shape of a new engine shop. Addressing the employés at the opening ceremony, Lieut. J. F. Sedcole, representing the Ministry of Munitions, said that although permission to begin the work had been obtained only last February, they had complete that day one of the most modern and best-equipped factories in the Sheffield district. Among those who took part in the opening ceremony were Mr. David Dalzield, M.P. (chairman), Sir Murland Evans, Mr. Arthur E. Jay (directors), Messrs. A. G. Wild (general manager), T. Durnan (secretary), and G. Koenigswerther and F. Miller (commercial manager).

To organise and control the Empire's trade in non-ferrous metals, the formation of the British Metal Corporation, Limited, with a capital of £5,000,000, will be officially announced directly. About half the amount has already been subscribed; and it is unlikely that any shares will be offered for public subscription. Those connected with the scheme include Mr. C. V. Sale, of Messrs. Sale & Company; Sir Charles Fielding, chairman of the Rio Tinto Company; Mr. A. W. Tait, chairman of the British Aluminium Company and the Otis Steel Company; Mr. C. Budd, of Vivian Younger & Bond; Mr. A. Hugh Smith, managing director of Cookson & Company; and Mr. C. W. Tennant, of Charles Tennant, Sons & Company.

The Middlesbrough Section of the National Association of Industrial Chemists, though it was only formed last January, is already thoroughly well organised, and there can be no doubt that a future of great usefulness lies before it. The new section has just been opened, new members are coming forward in gratifying numbers. The Education Committee of the section, in addition to arranging the programme of work, is regularly circulating data of interest to the members, and is, also, encouraging associates by offering prizes for essays on selected subjects. Rooms have been taken for meetings, and an employment bureau is now being established. The hon. secretary is Mr. Geo. C. Hogg, of Middlesbrough.

The directors of John I. Thornycroft & Company have recommended that the authorised ordinary capital of the company be increased from 150,000 shares of £1 each to 300,000 shares of a like denomination. The directors decided, when doubling the ordinary share capital, to issue such shares to the present ordinary shareholders, at par, 10s. per share paid-up, such 10s. to be provided out of the reserve fund, and absorbing £74,250; but, in addition, as further capital expenditure is necessary, to ask the shareholders to pay the remaining 10s. per share, producing £74,250. Shareholders not exercising their right of application for new shares will be entitled to receive their distribution of 10s. per share out of the reserve fund in cash.

The members of the Iron and General Metal Trades Section of the Iron, Steel, Tinplate, and Metal Merchants' Section of the Liverpool Chamber of Commerce have adopted resolutions protesting against the conclusions arrived at in the Report of the Departmental Committee of the Board of Trade appointed to consider the position of the iron and steel trades after the war. After alluding to the fact that the evidence of merchants and distributors has been entirely ignored, the Sections express the opinion that the Committee have based the majority of their recommendations more upon our attitude to present enemy countries after the war, than in providing for what will prove to be a much more important feature, viz., the relations which are likely to exist between ourselves and our Allies and neutrals under the entirely new conditions.

The attention of scale and weighing-machine manufacturers and repairers is drawn to the concession granted by the Priority Department of the Ministry of Munitions for the supply of metals required by them for industrial purposes for home trade. The metals may be used for repairs and maintenance of weighing apparatus of all capacities, but under this new rationing scheme no new weighing instrument may be manufactured, supplied, or sold with a capacity of more than 5½ cwt., total weight of 4¾ cwt., or exceeding the following values:—56 lbs. capacity £20, and 5½ cwt. capacity £50, without a special permit granted by the Priority Department of the Ministry of Munitions. Messrs. Price, Waterhouse & Company, chartered accountants, of 3, Frederick's Place, Old Jewry, E.C.2, have been appointed the rationing authority.

In addition to High Speed Steel Alloys, Ltd., various private firms have embarked upon the manufacture of tungsten powder, according to a paper read by Mr. J. Vogel, including the Thermo Electric Company, Blackwells, Continuous Rotation Company, British Thermit Company, Newcastle Alloys, Tyneside Alloys, Albright & Wilson, and one or two others. The Government entrusted Vice-Admiral Sir Edmund Slade with the control of the industry, and he secured the ore supply available from the British Empire at a uniform price. The relative merits of ferro-tungsten and tungsten powder are debatable. By direct reduction of the ore to ferro-tungsten the harmful impurities, sulphur, phosphorus, manganese, tin, arsenic, copper and lime are liable to be retained. In steel containing lower percentages of tungsten, the permissible impurities may be higher, and ferro-tungsten of suitable purity has some advantage in melting at a low temperature. Some steelmakers prefer it for use in electric furnaces.

Further particulars have been issued regarding the proposed formation of a Chemical Engineering Group of the Society of Chemical Industry. The council of

the society appointed a sub-committee to go more fully into the proposals of Prof. Hinchley and his supporters, and in view of the suggested wider scope of activity of the Chemical Engineering Section as compared with that of an ordinary section, the name "Chemical Engineering Group" has been provisionally adopted. It is proposed to constitute the group as a definite subject-section of the Society of Chemical Industry, membership of the group being open to all members of the society. Ordinary meetings of the group are to include conferences on special chemical engineering topics, these conferences to be held, at the discretion of the committee, in centres where the subjects to be discussed have particular local industrial importance. It is proposed to develop chemical engineering education and research as vigorously as possible. The establishment of a research fund is contemplated, the Chemical Engineering Group being charged with its allocation and supervision of the work done.

Mr. Frank Gilbertson, who was re-elected president of the Swansea Metal Exchange last month, said nothing could be more important in the reconstruction period than that the nation should stand by the principle of collective bargaining, and put down with a strong hand any attempts to substitute for it the power of the individual or the group to become a law to themselves, to act as though they were independent of other sections of the State, or to hold the nation to ransom. They must never forget that although the times of bitter commercial competition between industrial countries might not come at once, they would come again, and the only firm rock upon which to build was the low cost of production. Government control was and must be the enemy of low cost, and no one knew before the war the extent to which bureaucracy spelt decay and inefficiency. There were hopes in two directions. The first was in the growth of the spirit voiced in the Whitley Commission Report, which was the recognition by capital and labour of the need of learning each others' industrial problems, and the second was the accord given by Mr. Fisher in his educational reforms.

A scheme of considerable importance is being set on foot by the Salters' Company, who are founding an institution for the promotion of research in industrial chemistry and for the training and welfare of students and workers in that trade. It is to be called "The Salters' Institute of Industrial Chemistry," and for the present it will be housed at the Salters' Hall. As the first step a director will be appointed, and he will establish relations with the various Universities and technical institutions, as well as with the various branches of the chemical trade, in order that he may be in a position to assist students and others desirous of becoming industrial chemists as to their course of study and the best openings for their work. An important part of the scheme is the establishment of two types of Fellowships, for which post-graduate students of any recognised University will be eligible. The two classes are:—Fellowships to enable post-graduate students to continue their studies at an approved University or other institution under the general supervision of the director of the Institute, and Industrial Fellowships to enable suitably equipped chemists to carry on research for any particular manufacturer under an agreement which will be entered into between the Institute, the manufacturer, and the Fellow.

The annual meeting of the Cutlers' Company states that the total number of disused razors now received is no fewer than 303,000, of which 247,000 have been put into order and forwarded for the use of the troops. During the past year the company have received 106 applications for new trade marks. Of this number 35 marks have been accepted for registration and placed upon the register, and 41 are at present in the advertisement stage. The Steel Export Committee has entered upon its fourth year of existence, and the work goes steadily on, though the number of certificates granted is naturally reduced very considerably by the extensions made to the list of prohibited goods from time to time. Since its inception the Committee has granted over 200,000 certificates, this number being completed early in September. At the date of this report the number granted is 202,000. The most important item in the year's working refers to crucible cast steel In the Spring it was proposed to legalise the issue of Cutlers' Company certificates for this material. After mature consideration the War Trade Department ultimately decided to take over this branch of the work, and at the beginning of May crucible cast steel passed beyond the scope of the Committee. The War Trade Department have expressed their keen appreciation of the assistance rendered to them by the Committee.

In view of a conference which is to take place at Birmingham, on November 12, between representatives of the Ministry of Reconstruction and the brass and copper trades, the undernoted facts may be of interest. The motive of the conference is to discuss the formation in the brass and copper trades of an Interim Industrial Reconstruction Committee. It will be remembered that an informal conference of the trade was held in Birmingham, on July 17, when among the questions discussed three attracted considerable attention, namely, the demarcation of the boundaries of the industry, the grouping of the trade, and the further organisation of the trade as a whole. To obtain a well-considered view of these questions a small Advisory Committee was appointed, with Mr. E. G. Harcourt as chairman. This Committee has now presented a report, and the conference to be held on November 12 will be for the purpose of considering its recommendations. Invitations will be issued by the Minister of Reconstruction, under whose auspices the conference is being held, to all the trade associations and trade unions concerned in the industry. One question to be considered will be the position of metal merchants, dealers, and brokers, and also of export merchants. Associations of merchants are being invited to send representatives to the conference. But as possibly some associations may be overlooked, it is desired that any association, whether merchants or manufacturers, which can claim an interest in the the trade should have delegates at the conference, so that the opinion of the whole trade may be fully representative. Inquiries concerning the conference should be addressed to the Secretary of the Trade Organisation Commission at the Ministry of Reconstruction, 2, Queen Anne's Gate Buildings, Westminster, S.W.

In the course of their tour of the country the Greek commercial delegates visited the Lincoln works of Ruston & Hornsby, Limited, and the Sheffield works of Hadfields, Limited. At the former works it was indicated quite frankly in the speeches which followed the lunch that Greece was looking to England to play a considerable part in the reconstruction of the country after the war, and this particularly applied to agriculture. The Greek guests were made acquainted during a hurried tour with many processes of extraordinary war manufactures, whilst, lined up in impressive procession, was a selection of machines tackling the whole agricultural problem. The plough, the seed drill, the mower, the self-binder, the maize sheller, were followed by the straw bruiser finishing thrashing machine, which, in the harness of a Ruston traction or portable steam engine, takes the corn in the ear, cleans it of dust, delivers it into sacks, and chops and bruises straw for cattle food; all this with so many safety devices that the machinery is easily intelligible to any agricultural labourer, and is indeed practically and literally fool-proof. The delegates were also shown numerous other Ruston & Hornsby products. At Hadfields' works the delegates saw much that was impressive, the comprehensive scope of the firm's capabilities being fully demonstrated. As is to be expected in the present abnormal times, the arrangements made for coping with the Government war requirements perhaps attracted chief attention. Complete crushing

machinery of various classes was on view, including the firms' patent jawbreaker, which has a solid cast steel frame and patent "Era" manganese steel wearing parts; the "Heclon" gyratory rock and ore crusher; the "Hecla" disc crusher (Symons patent), together with many types of renewal parts in special steels the company have put on the market from time to time. Shells were seen in various stages of manufacture, right away from the casting of the ingots by Messrs. Hadfields' system to the forging, machining and finishing processes, including capping and banding. Considerable interest was taken in an exhibition of all sizes of projectiles that, whilst themselves remaining unbroken, have pierced the latest type of hard-faced plates of varying thicknesses up to 15 in. The Research Department had more to show than could really be satisfactorily covered in the relatively short time at the disposal of the visitors, who saw, amongst other tangible results of the care and experiments associated with the department, firing tests carried out on the firm's "Resista" steel helmets.

Mr. G. J. WARDLE, Parliamentary Secretary of the Board of Trade, recently received a deputation representing a number of institutions in regard to amending the Patent Law. The following societies were represented :—Iron and Steel Institute, Mr. F. W. Harbord; Junior Institution of Engineers, Mr. B. L. Dunbar Kilburn; Liverpool Engineering Society, Prof. Wemyss Anderson, Mr. J. Hamilton Gibson, and Mr. Dickinson; Manchester Association of Engineers, Mr. V. A. B. Hughes; Marine Engineers, Institute of, Mr. James Keith and Mr. James Adamson; Mechanical Engineers, The Institution of, Mr. Michael Longridge, Dr. H. S. Heleshaw, Mr. W. H. Patchell, and Sir George Croydon Marks; Mining Engineers, Institution of; Mining and Metallurgy, Institute of, Sir Robert Hadfield, Mr. Hugh K. Picard, and Mr. C. McDermid; Naval Architects, Institution of, Mr. A. E. Seaton, Mr. James Hamilton, and Mr. R. W. Dana; North-East Coast Institution of Engineers and Shipbuilders, Mr E. L. Orde, Hon. Sir Charles A. Parsons, and Sir Herbert Rowell; Royal Society of Arts, Mr. Campbell Swinton; Sheffield Society of Engineers and Metallurgists, Sir Robert Hadfield; South Wales Institute of Engineers, Mr. Thomas Sugden; Water Engineers, Institution of, Mr. Percy Griffith; Aeronautical Society of Great Britain, Mr. E. L. Pickles and Mr. W. Barnard Faraday; Automobile Engineers, Institution of, Mr. M. Atkinson Adam and Mr. Douglas Leechman; British Association for the Advancement of Science, Prof. John Perry and Mr. S. G. Brown; British Industries, Federation of, Sir Robert Hadfield; Chemical Industry, Society of, Mr. Walter F. Reid; Chemistry of Great Britain and Ireland, Institute of, Mr. H. Ballantyne and Dr. Passmore; Cleveland Institution of Engineers; Electrical Engineers, Institution of, Mr. W. M. Mordey and Mr. P. F. Rowell; Engineers, Society of, Mr. W. B. Esson, Mr. A. T. Bean, the Rt. Hon. Lord Headley, and Mr. A. S. E. Ackerman; Engineers and Shipbuilders in Scotland, Institution of, Mr. T. Blackwood Murray and Mr. J. Howden Hume; Gas Engineers, Institution of, Mr. Samuel Glover and Mr. W. T. Dunn; Inventors, Institute of, Mr. Walter F. Reid and Mr. Douglas Leechman. Discussion took place on the following subjects: Moratorium for patents; importance of product claims to chemical and other industries; extension of the term of patents, extension of the period of provisional protection, extension of the period for acceptance of the complete specification; reduction of patent fees; protection of patentees in relation to utilisation of their inventions by the State; limitation of provisions for revocation of patents; safeguarding patents of addition; and suggestions for a special tribunal to deal with patent cases. Mr. Wardle promised that the representations made would receive the consideration of the Board of Trade.

## Joint Consultative Committee on Labour.

The Admiralty and the Ministry of Munitions announce that the following is the composition of the Joint Consultative Committee, which has been set up in accordance with the recommendations of Mr. Justice McCardie's Committee of Inquiry, for the purpose of consulting with and advising the Admiralty and the Ministry of Munitions on such questions relating to labour as the Admiralty and the Ministry of Munitions may submit for their consideration :—

Sir Thomas Munro, K.B.E., Chairman (nominated by the Government).

Mr. W. F. Dawtry, Mr. J. Kaylor and Mr. G. Wilkinson (nominated by the Engineering Group of the Trade Union Advisory Committee to the Minister of Munitions).

Mr. Frank Smith, O.B.E., and Mr. W. J. Wentworth (nominated by the Trade Union representatives on the National Joint Committee of the Shipbuilders' Federation and Shipyard Trade Unions).

Mr. C. Duncan, M.P. (nominated by the less skilled Trades Group of the Trade Union Advisory Committee to the Minister of Munitions).

Sir Allan M. Smith, K.B.E., Mr. T. Philip Chatwin, Mr. D. S. Marjoribanks, Mr. A. S. Ross, C.B.E., and Mr. J. C. A. Ward (nominated by the Engineering Employers' Advisory Committee to the Minister of Munitions).

Mr. John Barr and Mr. A. M. Kennedy (nominated by the Employers' representatives on the National Joint Committee of the Shipbuilders' Federation and Shipyard Trade Unions).

Secretary, Mr. C. S. Hurst, Ministry of Munitions.

The Women's Trade Union Advisory Committee to the Minister of Munitions have also been invited to nominate one member on the Joint Consultative Committee.

## Machine Tools and Woodworking Machines.

A circular letter has been addressed by the Ministry of Munitions to all controlled establishments pointing out that it is an offence under Regulation 30A of the Defence of the Realm Regulations for any person to buy or sell a machine tool or woodworking machine without the permission of the Ministry, even although such tool or machine may be described as "scrap," and stating that in view of the fact that it has been brought to the notice of the Ministry that in certain cases machines have been bought and sold as "scrap" in contravention of the regulations, those regulations in future will be rigidly enforced.

The Machine Tool Department, Charing Cross Buildings, Embankment, must be notified of any machine tools or woodworking machines alleged to be "scrap," which a firm may have for disposal, so that inspection can be made on behalf of the Ministry. The firm will be informed as soon as possible after an inspection has been made whether the machine tools in question have been classified as "scrap" or as "serviceable" machines.

If the machine is classified as "scrap" the fact will be notified by the Ferrous Scrap Department, Whitehall Place, S.W. 1, and such "scrap" machine may only be disposed of in accordance with the instructions received from that Department.

If the machine is classified as a "serviceable" machine the fact will be notified by the Department of Engineering (Central Clearing House Section), and the machine will in that event be placed on the list of second-hand machines available for transfer kept by the Ministry, and notification of its ultimate disposal will be sent by the Machine Tool Department of the Ministry

## Personal.

THE late Mr. D. Makinson FOX, a director of Brown Bayleys Steel Works, Limited, left £107,376.

THE gross value of the estate of the late Mr. A. T. Keen, chairman of Guest, Keen & Nettlefolds, Limited, is £71,861.

THE gross value of the estate of the late Mr. W. H. Tomson, metal merchant, of Upper Thames Street, E.C., is £15,317.

THE late Mr. Isaac Bradley, of Thomas & Isaac Bradley, Limited, left estate valued at £19,103, including £16,768 net personalty.

MR. C. GOODCHILD, a departmental manager at the works of P. & W. MacLellan, Limited, Glasgow, has been elected a director of the company.

THE gross value of the estate of the late Mr. C. H. Halcombe, at one time managing director of Sanderson Brothers & Newbould, Limited, is £6,566.

THE gross value of the estate of the late Mr. W. H. Tomson, of Messrs. Chas. Hatton & Company, metal merchants, Upper Thames Street, London, E.C., is £15,317.

MR. E. P. BENNETT, the London and South of England manager of Simplex Conduits, Limited, has received an appointment in the Air Construction Service of the R.A.F.

THE late Mr. E. Sisterson, iron merchant, of Woodley Field, Hexham, and of Newcastle, left estate of the gross value of £195,542 7s. 3d., including net personalty of £160,733 16s. 4d.

THE Engineering Gold Medal of the North-East Coast Institution of Engineers and Shipbuilders has been awarded to Mr. H. R. Richardo, for his paper entitled "High Speed Internal Combustion Engines."

SIR EUSTACE HENRY WILLIAM TENNYSON D'EYNCOURT, K.C.B., Director of Naval Construction, has had the decoration of Commander of the Legion of Honour conferred upon him by the President of the French Republic.

MR. A. WEATHERHEAD, secretary of Harkess & Company, Limited, shipbuilders, Middlesbrough, has been elected managing director in the place of Mr. William Harkess, who has retired from that position, but retains a directorship.

Lieut. J. D. Davis, secretary of the Swansea Metal Exchange, who has been under the Roads and Railways Department of the R.E. in France since July, 1917, has been made captain and adjutant of his battalion.

SIR WILLIAM LORIMER has intimated his resignation as chairman of the Steel Company of Scotland, Limited, stating that he has been a director from the inception of the company 40 years ago and chairman for the past 23 years.

THE MINISTER OF MUNITIONS has appointed Mr. A. E. Berriman, chief engineer to the Daimler Company, to be Deputy Controller of the Technical Department of the Department of Aircraft Production of the Ministry, in succession to the late Professor Bertram Hopkinson, F.R.S.

SIR WILLIAM ELLIS, the Master Cutler, entertained the directors and staff of John Brown & Company, Limited, of which he is a director, to a dinner at the Cutlers' Hall, on September 25, when the opportunity was taken to present Sir William with his portrait in oils, subscribed for by the officials and staff.

WITH the usual formalities associated with the ancient company Lieut.-Colonel Sir Albert E. Bingham, Bart., was installed as Master Cutler of Sheffield, on October 3. The customary ceremonies of admission to office were also carried out in the cases of the Senior Warden (Lieut.-Colonel H. K. Stephenson, D.S.O.), the Junior Warden (Mr. William Clark), the searchers and assistants.

OWING to differences of opinion between the chairman and the other members of the board of the British Hydraulic Foundry Company, Limited, and in particular of late with regard to an increase of capital by way of free distribution of the company's reserves, Messrs. Jas. Reid, D. Y. Cassels and A. S. Macharg have retired from the directorate. Mr. Whiteon, the chairman, has acquired their shares at £11 10s. per share, and the vacancies on the board have been filled by the appointment of Mr. Archibald Gilchrist, engineer, and Mr. Noel E. Peck, shipbuilder.

## Applications for Patents.

*The names of communicators are printed in Italic type. A new number will be given when the Complete Specification is accepted.*

Alpha Products Company. Processes for making castings of rare earth metals. 15,122. September 17. (United States, September 17, 1917.)
Armstrong, J. Metallurgy of iron and steel. 15744. September 27.
Arnold, J. O. High-speed steel. 15554. September 25.
Aubert, A. M. Regenerative tipping furnaces. 16,518. October 10. (France, October 22, 1917.)
Cammell, Laird & Company, and Carter, Sir G. J. Furnaces for melting metals, etc. 15551. September 25.
Crosby, E. L. Electric furnaces. 15600. September 25.
Davis, H. N., and Twigg, W. R. Gas-fired regenerative furnaces. 16,324. October 7.
Driver-Harris Company. Means for heat-treating metallic articles. 16,524. October 10. (United States, February 1.)
Etchells, H., and Greaves, H. A., and Watson & Company, T. H. Electric furnaces. 15543. September 25.
Eyre Smelting Company. Liquid-fuel burners. 16,151 October 4.
Hale, W. E. Steel castings. 15698. September 26.
Harvey, F. A., and Nutt, A. T. Construction of doors for metallurgical, etc., furnaces. 16,238. October 7.
Harvey, E. W., and Harvey Gas Furnace Company, E. W. Regenerative or recuperative gas furnaces for heating or melting metals. 17,068. October 18.
Lawton, T. A. D. Electric furnaces. 15812. September 28.
McDowell, J. A. Studs for foundry purposes. 16,015. October 2.
MacKenzie, K. D. Treatment of metals. 15,285. September 20.
Mate, W. C. A., and Poulson, A. Production of malleable iron. 15806. September 28.
Munden, R. A., and Shilton, W. A. Crucible furnaces. 16,937. October 17.
Neilsen, E., and Parker Foundry Company. Apparatus for making castings in permanent moulds or chills. 15826. September 28.
Petherick, J. Open-hearth melting-furnaces. 15,961. October 1.
Schneider et Cie. Ascertaining hardness of metal articles. 16,390. October 8. (France, November 7, 1917.)
Soc. C. M. Stein et Cie. Annealing-furnaces. 16,817. October 10. (France, August 24.)
Speirs, C. W. Current-regulating devices for electrically-heated crucible retorts, muffles, melting-furnaces, etc 16,673. October 12.
Shedlock, J. J. Manufacturing alloys of metals, and electrodes therefor. 16,739. October 14.
Shotton, E. R. Process for manufacturing iron for malleable iron castings. 15720. September 27.
Williams, A. L. W. Alloy. 15555. September 25.
Williams, J. W. Furnaces for melting metals, etc. 15551. September 25.

## Returns as to Forgings and Castings.

The Minister of Munitions has issued an Order to the effect that every person engaged in the production of ferrous forgings or drop forgings or castings must furnish to the Controller of Forgings and Castings, Ministry of Munitions, 8, Northumberland Avenue, London, W.C.2, such particulars as to output, plant and work-people employed, and as to orders and contracts, as required. The Order is cited as the Ferrous Forgings (Returns) Order, 1918.

**MICA SCHIST FOR FURNACE LINING.**—The mica, to which the softness of mica schist is due, successfully withstands a very high temperature, and as the stone can be readily cut into blocks of the desired shape, mica schist has been used considerably as furnace lining. According to the U.S. Geological Survey, the quantity of mica schist produced in the United States for this purpose in 1917 was 39,975 short tons (of 2,000 lbs.), an increase of 6,739 tons over 1916.

# MOULDING MACHINES

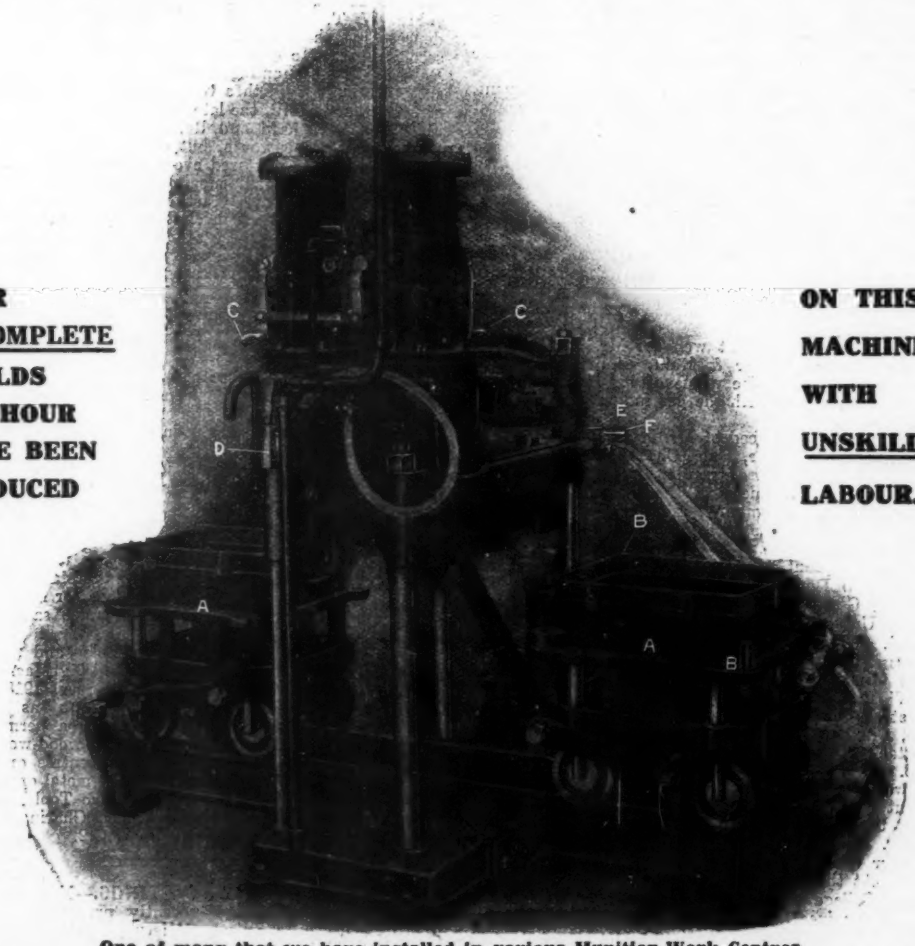
## OF EVERY DESCRIPTION.

**Pneumatic, Hydraulic, Jar Ramming, & Hand Power.**

**Type "A" Duplex Machine for Pneumatic Power.**

**Fitted with self-adjusting Rammer Head which accommodates itself to any varying depth of pattern.**

**OVER 50 COMPLETE MOULDS PER HOUR HAVE BEEN PRODUCED**




**ON THIS MACHINE WITH UNSKILLED LABOUR.**

One of many that we have installed in various Munition Work Centres.

**JAMES EVANS & CO., BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.**

## Deaths.

Mr. J. David, at one time proprietor of the Vulcan Foundry, Merthyr, died recently at the age of 74 years.

The death took place on September 27 at 34, Broomwood Road, S.W., of Mr. W.W. Williams, M.I.Mech.E., aged 72 years.

The death is reported of Mr. J. O. Callender, a director of Callender's Cable & Construction Company, Limited, of Leigh and Erith (Kent).

Lieut. C. Levick, presumed killed in action, was previously associated with his father in the business of John Levick, Limited, metal spinners, of Birmingham.

Mr. H. J. Quicke, M.B.E., for thirty years manager and technical adviser of the Blaydon Iron Works, has died at his residence, Ryton-on-Tyne, at the age of 67 years.

The death took place recently of Mr. A. S. Eeslemont, late Controller of the Optical Munitions, Glassware and Potash Production Department of the Ministry of Munitions.

Lieut. J. V. Townsend, West Yorkshire Regiment, who has been killed in action in France, was a son of the late Mr. J. E. Townsend, for many years secretary to John Brown & Company, Limited.

Lieut. Sherard William Cowper-Coles was killed in action on October 4 (while Acting Flight Commander R.A.F.). The deceased, who was aged 22, was the eldest son of Mr. W. B. Cowper-Coles.

We regret to announce the death of Mr. T. C. Hutchinson, J.P., the managing director of the Skinningrove Iron Company, Limited, to whose courageous enterprise much of the industrial development of Cleveland is due. Mr. Hutchinson was born at Stockton in 1840.

The death occurred last week of Mr. R. B. Main, the chairman of Glover & Main, Limited. He was 68 years of age, and the whole of his business career had been associated with the gas industry and general ironfounding.

The death is announced of Mr. J. F. L. Crosland, at his residence, Belcombe, Hale, Cheshire, at the age of 79 years. The deceased gentleman retired from the position of chief engineer of the Vulcan Boiler and General Insurance Company, Limited, in 1912, after nearly 50 years' service with the company.

Captain W. F. M. Donald, M.C., who has been killed at the Front, was the third son of the late Mr. Colin Dunlop Donald, of Messrs. M'Grigor, Donald & Company, Glasgow. He was educated at Rugby, and Glasgow University, where he passed B.Sc. (civil engineering). When the war broke out he was assistant to Messrs. Crouch & Hogg, C.E.

Mr. Thomas M. Percy, J.P., general manager of the Wigan Coal and Iron Company's blast furnaces and steel department, died on Oct. 22 at his residence, Cinnamon House, Ince, near Wigan, following an attack of influenza upon which pneumonia supervened. The deceased gentleman, who was 68 years of age, was a prominent member of the Iron and Steel Institute, and was a brother of the late Mr. C. M. Percy, the well-known mining engineer.

Lieut. P. M. Chadwick, R.E., killed in action, was the elder son of Mr. Ellis Chadwick, of Parkstone, Dorset. At the end of the three years' course at the Imperial College of Science and Technology he took his B.Sc. in Engineering, and became an articled pupil with Mr. Bailey Denton, Westminster. He then spent a year on the New Docks at Southampton as assistant to the chief engineer, and was appointed a lecturer at the City and Guilds Technical College, Finsbury. From there he passed to Birmingham University as one of the lecturers in engineering.

Mr. H. Dyer, a distinguished engineer, has died at the age of 80 years. The deceased gentleman, in 1870, gained the first Whitworth Scholarship for Scotland, and also the chief honour at the University in science and engineering. Shortly afterwards he was appointed professor of an engineering college in Tokio, returning home ten years later. On the establishment of the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trades of the West of Scotland he was elected deputy-chairman, and was a life governor of the Glasgow Technical College.

Lieut. Graham Johns, Scots Guards, who was killed in action on September 27, was the second son of Mr. Cosmo Johns, Sheffield, late of Swansea. Lieut. Johns was educated at the Junior School, Loretto, and Cheltenham College, where he played in the fifteen. He matriculated at Caius College, Cambridge, but did not go into residence. He was gazetted from a Cadet Unit at Cambridge to the Scots Guards, and was severely wounded at Ypres last year. He returned to France in March this year. He was engaged for a few months as engineering pupil at Vickers, Ltd., Sheffield, until he reached the age for entering a Cadet Unit. He was 21 years of age.

Mr. W. T. Crawshay died last month at his residence, Caversham Park, near Reading, in his seventy-second year. He was the eldest son of the late Mr. Robert Chawshay and grandson of the William Crawshay who built Cyfarthfa Castle in 1825. On the death of his father in 1879, the late Mr. W.T. Crawshay, with his brothers Richard and Robert Crawshay, inherited the Cyfarthfa Ironworks, but of the brothers he was the only one who mastered every detail of the business and exercised personal supervision over the works. After removing from Cyfarthfa Castle to Caversham Park, Reading, he kept in close touch with the undertaking until it was finally acquired by Guest, Keen & Nettlefolds, Limited, who, after closing it down in 1910, re-opened it two years ago.

## Machine Tools.

It is not generally understood that orders for machine tools for work, other than war work, may now be placed with manufacturers, merchants, and importers without submission to the Ministry of Munitions for approval.

While the Ministry of Munitions has notified traders that they may place such orders on their books, they are not permitted to manufacture or supply until the present restrictions are withdrawn.

For the time being, therefore, no machine tools may be manufactured except for the purpose of satisfying definite munitions orders approved by the Machine Tool Department of the Ministry of Munitions, or in accordance with manufacturing programmes also sanctioned by that Department.

With reference to the Machine Tools and Power Machinery Order, 1916, the Wood Working Machinery Order, 1917, and the Treadle Lathes Order, 1918, the Minister of Munitions gives notice that as from September 16, 1918, all applications for a permit to purchase machine tools, power-driven wood-working machinery, or treadle lathes of 3 in. centres or over suitable for use in cutting and working metal or wood, must be made to the Controller, Machine Tool Department (T.M.7), Ministry of Munitions, Charing Cross Buildings, Embankment, London, W.C.2.

**VANADIUM ALLOY CASTINGS.**—Mr. R. F. Flinterman, in a Paper recently presented to the American Electrochemical Society, mentioned some "wonderful" tests the Michigan Steel Castings Company, of Detroit, have been getting from vanadium steel. They were as under :—

| | No. 1 | No. 2. |
|---|---|---|
| Ultimate strength, lbs. per sq. in. ... | 102,000 | 103,800 |
| Elastic limit, lbs. per sq. in. ... ... | 81,500 | 84,000 |
| Elongation in 2 in., per cent. ... ... | 23 | 21 |
| Reduction in area, per cent. ... ... | 48 | 47 |

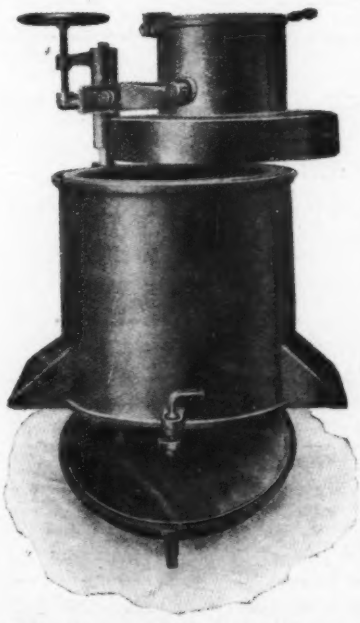
These tests were obtained repeatedly and, according to the author, can be reproduced commercially.

# MACNAB & Co.,

## 56/8, Eagle Street, Southampton Row, LONDON, W.C.1.

## Reduce your fuel cost! Melt in a hurry!

### For Brass, Gunmetal, Aluminium, Iron, etc.

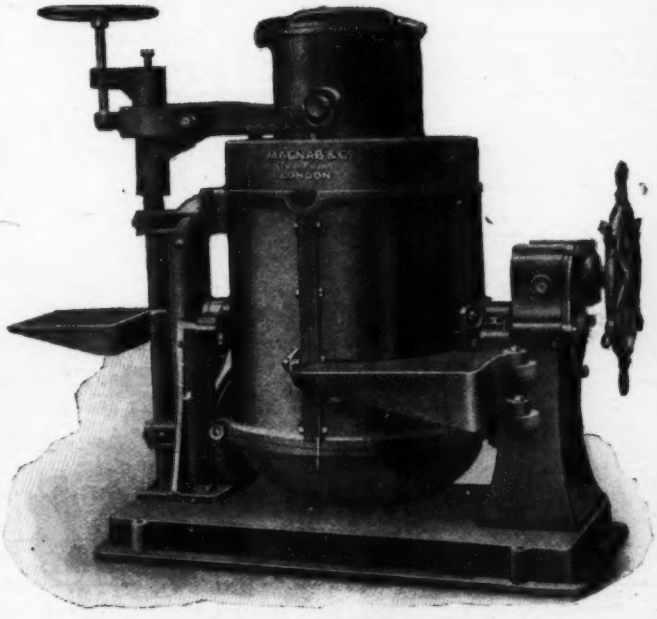


**Tylor Patent Pit-Type Furnace.**

**OUTPUT.**
200 lbs. Admiralty Gunmetal melted in 25 minutes. Temperature 2000° F.

**ECONOMY.**
20 lbs. of Coke used per 200 lbs. of Metal melted.

**STANDARD CRUCIBLES.**
Lasting 35 to 40 heats.




**Tilting-Type Furnace.**

**OUTPUT.**
400 lbs. Admiralty Gunmetal melted in 45 minutes. Temperature 2000° F.

**ECONOMY.**
73 lbs. of Coke used per 400 lbs. of Metal melted.

**STANDARD CRUCIBLES.**
Lasting 35 to 40 heats.

## New Companies.

**Tees Iron & Hardware, Limited.**—Capital £15,000 in £1 shares.

**Stannaries Metal Company, Limited.**—Capital £5,000 in £1 shares.

**Midland Saw & Tool Company, Limited.**—Capital £5,000 in £1 shares.

**C. P. Parry, Limited.**—Capital £26,000 in £1 shares, to carry on the business of ironfounders.

**Luton Metals, Limited.**—Capital £5,000 in £1 shares. Registered office :—Hitchin Road, Luton.

**Barclay & Co., Limited.** Capital £20,000 in £1 shares, to carry on the business of engineers.

**Coventry Spring Company, Limited.**—Capital £100 in £1 shares. Registered office :—Empire Works, Claredon Street, Coventry.

**St. Helens Smelting Company, Limited.**—Capital £75,000 in £1 shares. Registered office :—29, Gracechurch Street, E.C.

**Sheffield Shears Company, Limited.**—Capital £3,000 in £1 shares. The first directors are : Frank Smith, Fred Smith and Wm. Sykes.

**Uzal, Limited.**—Capital £5,000 in £1 shares (3,334 ordinary and 1,666 deferred), to carry on the business of fireclay manufacturers.

**Allies-Utilities, Limited.**—Capital £5,500 in 5,000 preference shares of £1 and 10,000 ordinary of 1s., to carry on the business of machinery manufacturers.

**British Federation of Iron, Steel, Tinplate and Metal Merchants (Incorporated).**—Limited by guarantee. Registered office :— 5, East India Avenue, E.C.

**Don Forge & Engineering Company, Limited.**—Capital £10,000 in £1 shares, to purchase the business carried on by M. H. Allott at Don Forge, Rotherham. The governing director is M. H. Allott.

**Fellows & Darby, Limited.**—Capital £3,000 in £1 shares. Patternmakers. Directors : C. H. Fellows and D. Darby. Registered office : 45, Slaney Street, Birmingham.

**Newey & Homer, Limited.**—Capital £25,000 in £1 shares, to take over the business of brass and ironfounders carried on at London Fields, Dudley, as Newey & Homer.

**John Gibson & Son, Limited.**—Capital £20,000 in £1 shares, to take over the business of engineers and motor manufacturers now carried on by John Gibson & Son. Registered office :—109, Leith Walk, Leith.

**Severn Engineering Company, Limited.** — Capital £7,000 in £1 shares, to take over the business carried on at the Severn Engineering Works, Tybridge Street, Worcester, as the Severn Engineering Company.

**Wm. Thomlinson-Walker, Limited.**—Capital £5,000 in £1 shares, to acquire the business of an ironfounder, etc., carried on by Mr. J. R. Walker, Victoria Ironworks, Walmgate, York, as Wm. Thomlinson-Walker.


**Still the Premier**

FURNACE MAKERS FOR MELTING, ANNEALING, HARDENING, &c. AND HEAT TREATMENT OF METALS.

OVEN FURNACES, gas, oil or solid-fuel fired. Fitted with Monometer Automatic Heat Controller.

CRUCIBLE and NON-CRUCIBLE MELTING FURNACES, gas, oil or solid-fuel fired. Tilting and Stationary Type, for STEEL, Iron, Copper, Gunmetal, Brass and all non-ferrous and ferrous metals.

HIGH SPEED STEEL FURNACE. Twin-chambered, gas or oil-fired. Even heat throughout chambers.

HEAT CONTROLLED FURNACES, for melting aluminium, lead, tin, antimony and all white metals.

DE-TINNING FURNACES.

WIRE TINNING FURNACES.

CABLE COVERING FURNACES.

OPEN-HEARTH FURNACES.

DIE-CASTING MACHINES, for casting bearings, &c.

BLOWERS, COMPRESSORS, FANS, Etc.

**MONOMETER MANUFACTURING CO. (1918) Ltd., Whitehouse St., ASTON, BIRMINGHAM.**

*Chairman :* H J. THOMAS. *Managing Director and Engineer :* I. HALL, M.I.MECH.E., M.I.S.I. and I.M.

**LEGGE'S IRON CEMENT.**

The most efficient for general Engineering and Foundry Work.

It repairs permanently and effectively makes good all defects in Castings, leaking parts and connections in Steam, Water, Gas and Air, etc.

WRITE TO MANUFACTURERS—

16, South Castle St., **F. THOMPSON LEGGE & CO.** LIVERPOOL.

**FERRO-VANADIUM.** * * * * **FERRO-TITANIUM.**

**SILICO-MANGANESE** { 23/30 % Silicon. 65/70 % Manganese and 1 %, 2 %, 3 %, Carbon Maximum.

**FERRO-SILICON** Containing 25 %, 50 %, 75 % Silicon.

**FERRO-CHROME** 65/70 % Cr. & 1 % up to 8/10 % Carbon Maximum.

**MAGNESIUM METAL** 99 %. *In Sticks and Powder and Magnesium Copper.*

WE SUPPLY ALL CLASSES OF MINERALS, METALS AND METALLIC ALLOYS.

**EVERITT & CO.,** 40, CHAPEL ST., LIVERPOOL.

Telegrams : "PERSISTENT." Telephone No. 1134 (3 lines).

# SEMI-STEEL SHELLS!

If you wish to be successful in the manufacture of the above it is essential that you use

# "SPERMOLIN"

*(Registered Trade Mark)*

for your CORES, which will overcome all difficulties.

## AS SUPPLIED TO H.M. WAR OFFICE.

*For particulars apply to the Makers:—*

**THE SPERMOLIN CORE CO.,**

**HALIFAX.**

Telegrams:—"SPERMOLIN, HALIFAX."
Telephone: 397 HALIFAX.

**Tappets, Limited.**—Capital £5,000 in £1 shares, to take over and extend the business of the manufacture of tappets, valves, etc., carried on by Messrs. Gainsford, Power & Company, of the Advance Works, Northampton. First directors: D. H. Gainsford, J. C. Power and J. H. Freeborough.

**Henry Witham & Company, Limited.**—Capital £50,000 in £1 shares, to take over the business of artillery wheel manufacturers, etc., carried on by H. Witham at Cranmer Street, Long Eaton, as Witham & Company. Registered office: 68, Cranmer Street, Long Eaton, Derby.

**W. A. Cross & Company, Limited.**—Capital £15,000 in £1 shares, to acquire the business of bedstead makers, brass founders, etc., carried on by W. A. Cross and J. M. Doughty as Cross & Company, at Blews Street, Birmingham. Permanent directors: W A. Cross and J. M. Doughty. Registered office: Apollo Works, Blews Street, Birmingham.

**Fermans (1918), Limited.**—Capital £100,000 in £1 shares, to take over the business of manufacturers of die castings in aluminium and other metals carried on at Mitre House, Scrubbs Lane, Willesden Junction, as Fermans, Limited. The first directors are H. Smith, A. Bednell, and C. C. Fowler. Registered office:—Mitre House, Scrubbs Lane, Willesden Junction, N.W.

**British Steel Corporation, Limited.** — Capital £1,000,000 in £1 shares. The subscribers (each with one share) are:—R. V. Vassar-Smith, Charlton Park, Charlton Kings, Gloucester, banker; J. C. Davies, The Mount, Gowerton, Glamorganshire, ironmaster; J. R. Wright, Hendrefoilan, Sketty, Glamorganshire, ironmaster; R. Tilden Smith, 13, Upper Brook Street, London, colliery proprietor. All directors must be British subjects, and other provisions, in form approved by the Board of Trade, are inserted in the articles with a view of excluding foreign control. Registered office:—70, Lombard Street, London, E.C.


**VERZOCCHI & DE ROMANO**

**MILAN (Italy).**

Importers of

**MINERALS. METALS. ALLOYS.**

also

***REFRACTORY MATERIALS and all requisites for the Engineering Trades.***

**Correspondence Invited.**



*Published at the Instruction of the Ministry of Munitions of War by the Imperial College of Science and Technology and the University of Liverpool.*

**A Memoir on BRITISH RESOURCES of**

**REFRACTORY SANDS**

**FOR FURNACE & FOUNDRY PURPOSES.**

***PART I.***

**By P. G. H. BOSWELL, O.B.E., D.Sc.,**

Professor of Geology in the University of Liverpool, Scientific Adviser (Geological) to the Department of Iron and Steel Production, Ministry of Munitions of War.

WITH CHEMICAL ANALYSES BY

H. F. HARWOOD, M.Sc., Ph.D., and A. A. ELDRIDGE; B.Sc., F.I.C.

Demy 8vo. 233 pp., 7 plates and 4 maps. Price **8s. 6d.** net.

**London: TAYLOR & FRANCIS, Red Lion Court, Fleet St., E.C.4**



**The Mastery** SIROCCO **of the Air.**

TRADE SIROCCO MARK

**FANS**

**SEND US YOUR ENQUIRIES FOR**

**are always successful in the struggle for the Mastery of the Air**

Ventilation of Ships, Buildings and Mines, Induced Draught on Boilers, Dust Removal, High Pressure Fans for Forge Fires and Cupolas, Air Washers for Cooling and Purifying the Air, Fans for Removing Fumes or Steam, Steam Heater Units for Heating Factories and Workshops.

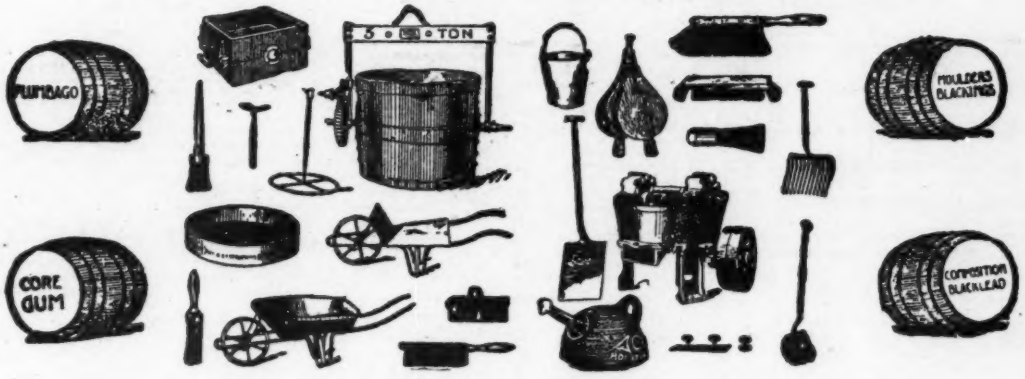
**Davidson & Co., Limited,** *Sirocco Works,* **BELFAST.**

Telegrams: "Durrans, Penistone." Telephone: 21, Penistone

*Established 1863.*

# JAS. DURRANS & SONS,

## Phœnix Works, Penistone, Near Sheffield.



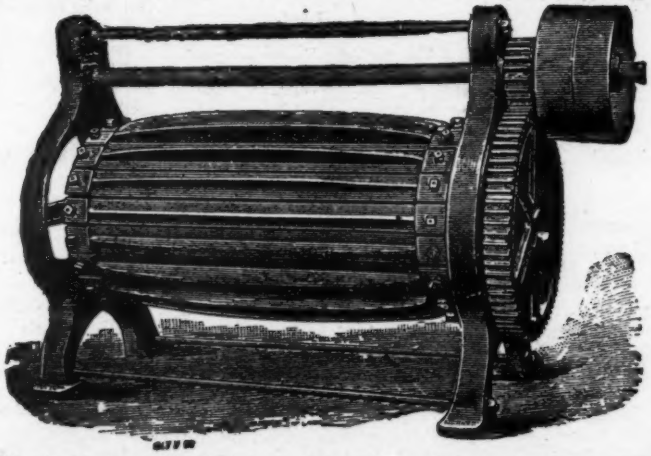

Manufacturers of all

## *FOUNDRY EQUIPMENTS*

**COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST**

**Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.**

## Improved Foundry Rattler or Fettling Drum.



**These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.**

The following testimonial explains itself:—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

# MONTHLY PRICE LIST.

**The undermentioned prices, unless otherwise specified, are those obtaining at the commencement of the current month.**

## CONTROL PRICES.

### Pig-Iron.

| | £ | s. | d. |
|---|---|---|---|
| West Coast hematite, mixed Nos. 1, 2 and 3 .. .. .. | 6 | 7 | 6 |
| Special under 0.03 P. & S... .. | 6 | 15 | 6 |
| „ „ 0.02 „ .. .. | 7 | 0 | 0 |
| East Coast hematite, mixed Nos. 1, 2 and 3 .. .. .. | 6 | 2 | 6 |
| Special under 0.04 P. & S. .. | 6 | 7 | 6 |
| Special under 0.03 P & S. .. | 6 | 15 | 6 |
| „ „ 0.02 „ .. .. | 7 | 0 | 0 |
| Scotch hematite, mixed Nos. 1, 2 and 3.. .. .. .. | 6 | 2 | 6 |
| Special under 0.03 P. & S. .. | 7 | 10 | 0 |
| Welsh hematite, mixed Nos. 1, 2 and 3 .. .. .. .. | 6 | 2 | 6 |
| Special under 0.03 P. & S. .. | 6 | 15 | 6 |
| „ „ 0.02 „ .. .. | 7 | 0 | 0 |
| HEMATITE—MALLEABLE— | | | |
| Refined— | | | |
| Refined Cupola Cast .. .. | 8 | 0 | 0 |
| Refined Cupola Cast to guaranteed analysis.. .. .. | 8 | 5 | 0 |
| Cast direct from Blast Furnaces— | | | |
| Small Pig-Iron, all grades .. | 7 | 10 | 0 |
| Medium Pig-Iron White to Grey mottled .. .. .. | 7 | 5 | 0 |
| Medium Pig-Iron, all other qualities .. .. .. | 6 | 17 | 6 |
| Large Pig-Iron, all grades .. | 6 | 17 | 6 |
| Lincolnshire, basic or foundry .. | 4 | 17 | 6 |
| Cleveland, No. 1 .. .. .. | 4 | 19 | 0 |
| „ other grades .. .. | 4 | 15 | 0 |
| „ basic .. .. .. | 5 | 0 | 0 |
| Northamptonshire, forge .. .. | 4 | 7 | 6 |
| „ fdy. numbers | 89/0 | | 94/0 |
| „ basic .. .. | 4 | 17 | 6 |
| Derbyshire, forge .. .. .. | 4 | 10 | 0 |
| „ foundry numbers | 92/6 | | 96/6 |
| Derby & Notts. basic. .. .. | 4 | 17 | 6 |
| Leicestershire & Notts., forge .. | 4 | 10 | 0 |
| „ „ foundry nos. | 92/6 | | 96/6 |
| North Staffs, forge .. .. .. | 4 | 15 | 0 |
| „ „ foundry .. .. | 4 | 17 | 6 |
| „ „ basic .. .. .. | 4 | 17 | 6 |
| South Staffordshire— | | | |
| Part mine forge .. .. .. | 5 | 0 | 0 |
| „ foundry .. .. | 5 | 2 | 6 |
| Common Staffordshire .. | 4 | 15 | 0 |
| All mine forge .. .. .. | 5 | 15 | 0 |
| „ foundry .. .. | 6 | 0 | 0 |
| Warm air forge .. .. | 7 | 5 | 0 |
| „ foundry .. .. | 7 | 15 | 0 |
| Lord Dudley's silicon .. .. | 8 | 7 | 6 |
| Cold blast .. .. .. | 9 | 2 | 6 |
| Basic .. .. .. .. | 4 | 17 | 6 |
| Scotch foundry and forge— | | | |
| Nos. 2, 4, and lower grades of Monkland, Dalmellington, Eglinton, and Govan.. .. | 5 | 14 | 0 |
| Nos. 3, 4, and lower grades of all other brands .. .. | 5 | 15 | 6 |

No. 1 quality in all cases to be 5s. per ton above these prices.

All per ton net, f.o.t. makers' works. Mers. Com. 1½%

In all districts 1s. extra may be charged for Basic cast in chills.

### High-Speed Tool Steel.

The maximum prices for high-speed tool steel have been fixed as follows:—

Finished bars, 14% Tung. 3s. 8d.

Finished bars, 18% Tung. 4s. 5d.

Per lb. basis. Extras as per authorised list. These prices are net delivered buyers' works.

The fixed prices for scrap which must be returned to steel makers' works are as follows:—

Millings and Turnings .. .. 8d.

Bar Ends .. .. .. .. 9d.

Both per lb. net delivered steel makers' works.

### Ferro-Alloys

Net, Delivered Sheffield steel works.

| | £ | s. | d. |
|---|---|---|---|
| Ferro chrome: 4/6% carbon. Basis 60%, scale 10s. per unit Per ton | — | | |
| Ferro-chrome: 6/8% carbon. Basis 60%, scale 10s. per unit. Per ton | — | | |
| Ferro-chrome: 8/10% carbon. Basis 60% scale, 10s. per unit Per ton | — | | |
| Ferro-chrome: Specially refined, guaranteed maximum 2% carbon broken to small pieces for use in best quality crucible steels. Basis 60%, scale 32s. per unit. Per ton | — | | |
| Ferro-vanadium: 33/40% Va., per lb. of Va. contained in the alloy | — | | |
| Ferro-silicon: 45/50%. Basis 50%, 5s. scale per unit .. Per ton | — | | |
| Ferro-titanium: 23/25%, per lb. carbonless.. .. .. .. | — | | |
| Ferro-molybdenum: 70/80% Mo. per pound of Mo. contained .. | — | | |
| Ferro-phosphorus: 20/25%. Per ton | — | | |
| Ferro-tungsten: 75% to 80% per lb. of metallic tungsten contained | — | | |
| *Ferro-manganese 80% .. .. | 26 | 10 | 0 |
| „ export | — | | |

* F.o.b. Liverpool.

### Non-Ferrous Metals.

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| **Copper.** | | | | | | |
| Standard, Cash .. | 122 | 0 | 0 | 122 | 10 | 0 |
| Three months .. | 122 | 0 | 0 | 122 | 10 | 0 |
| Electrolytic .. .. | 137 | 0 | 0 | 133 | 0 | 0 |
| Tough .. .. | 135 | 0 | 0 | 131 | 0 | 0 |
| Best selected .. .. | 135 | 0 | 0 | 131 | 0 | 0 |
| **Tin.** | | | | | | |
| Standard, Cash .. | 329 | 10 | 0 | 330 | 10 | 0 |
| „ Three months | 323 | 10 | 0 | 324 | 10 | 0 |
| English Ingots .. | 332 | 0 | 0 | — | | |
| Bars .. .. .. | 333 | 0 | 0 | — | | |
| Refined .. .. | — | | | — | | |
| **Spelter.** | | | | | | |
| American .. .. | 54 | 0 | 0 | 50 | 0 | 0 |
| Specials.. .. .. | — | | | — | | |
| Hard .. .. | 45 | 0 | 0 | 46 | 0 | 0 |
| British .. .. | 56 | 10 | 0 | 57 | 0 | 0 |
| **Lead.** | | | | | | |
| Soft Foreign (net) .. | 29 | 10 | 0 | 28 | 10 | 0 |
| English .. .. | — | | | Nom. | | |
| **Antimony.** | | | | | | |
| Regulus .. .. | — | | | 85 | 0 | 0 |

**Aluminium.**

Virgin Metal 98/99% per ton — —

**Phosphor Bronze.**

| INGOTS. | Per ton |
|---|---|
| Alloy No. I. or II .. .. | — |
| III., IV. or V. .. .. .. | — |
| VI. or VII. .. .. .. | — |
| VIII. .. .. .. | — |
| XI. .. .. .. | — |
| Cast Strips and Ingots.. .. .. | — |
| CASTINGS. | Per lb. |
| I. or II. .. .. .. | — |
| III. IV. or V. .. .. .. | — |
| VI. or VII .. .. .. | — |
| VIII. .. .. .. | — |
| XI. .. .. .. | — |
| No. VII., Chill, Cast, Solid .. | — |
| „ Cored Bars .. .. | — |

Delivery 2 Cwt. free to any town.

10 per cent. Phosphor Copper .. £50 above price of best selected copper.

15 per cent. Phosphor Copper .. £70 above price B.S.

Phosphor Tin (5 per cent.) .. £30 above price of English Ingots.

(Phosphor-bronze prices supplied by CHARLES CLIFFORD AND SON, LIMITED, FARNLEY STREET MILLS, BIRMINGHAM).

***Chromium (Metallic).**

98/99% purity, per lb. — —

***Nickel.**

In cubes, 98/99% purity Per ton —

**Nickel Silver.** per lb.

Ingots for raising .. .. —

Ingots for Spoons and Forks .. —

„ rolled to spoon size .. —

***Tungsten Metal Powder.**

96/98% purity.. per lb. .. —

***Molybdenum Metal.**

96/98% purity.. per lb. .. —

***Cobalt Metal.**

97% purity .. per lb. .. —

**Quicksilver.**

75 lb. bottle .. .. .. —

* Net, Delivered Sheffield Works.

### Scrap Iron and Steel.

| | Cleveland. | s. | d. | s. | d. |
|---|---|---|---|---|---|
| Steel scrap, heavy melting.. | | — | | — | |
| Iron scrap cast (cupola metal) .. .. .. | | — | | — | |
| | **London (f.o.b.).** | | | | |
| Heavy steel .. .. .. | | | | 104 | 6 |
| Light „ .. .. .. | | | | 55 | 0 |
| Heavy cast .. .. .. .. | | | | 110 | 0 |
| | **Control Prices.** | | | | |
| Heavy Steel Melting Scrap 105 | | 0 | | 125 | 0 |
| Steel Planings, Turnings and Borings | | | | 65 | 0 |
| Steel Planings, Turnings and Borings mixed with Wrought Iron, &c. | | | | 50 | 0 |
| Steel Scrap, all other Classes .. | | | | 95 | 0 |
| Wrought Iron Scrap .. .. | | | | 125 | 0 |
| Ditto, mixed with Steel .. .. | | | | 95 | 0 |
| W.I. Planings, Turnings and Borings mixed with Steel, &c. .. .. | | | | 50 | 0 |

Per ton delivered Buyers' Works.

### Cast-Iron Scrap.

| | £ | s. | d. |
|---|---|---|---|
| Hy. ord. brkn., between 1½ cwt. and 10 cwt. .. .. .. .. | 4 | 15 | 0 |
| Hy. machy., brkn., bet. 1½ cwt. and 10 cwt. .. .. .. .. | 5 | 0 | 0 |
| Cold blast, brkn., bet. 1½ cwt. and 10 cwt. .. .. .. .. | 6 | 15 | 0 |
| Ingot mould, unbroken .. .. | 6 | 0 | 0 |
| Ditto, brkn., bet. 5 cwt. and 2 tons | 6 | 5 | 0 |
| Ditto, between 1½ cwt. and 5 cwt. | 6 | 10 | 0 |
| Extra for breaking into pieces not exceeding 1½ cwt. .. .. .. | 0 | 5 | 0 |
| Railway chairs for re-melting .. | 5 | 0 | 0 |
| Heavy lumps, not above 2 tons .. | 4 | 12 | 6 |
| Light .. .. .. .. | 4 | 5 | 0 |
| Burnt, broken, ready for cupola .. | 3 | 0 | 0 |
| Burnt fire bars .. .. .. | 4 | 0 | 0 |
| Turnings and borings for iron and steel makers .. .. .. | 3 | 5 | 0 |

Per ton f.o.r. or f.i.b. Scrap merchants' commission, 2½ per cent.; additional 10s. allowed, except for railway chairs and turnings and berings, to cover inwards carriage and handlings on sales from scrap yards.

### Coke.

| | Middlesbrough. | s. | d. | s. | d. |
|---|---|---|---|---|---|
| Gas Coke .. .. .. | | — | | 50 | 0 |
| Foundry .. .. .. | | 65 | 0 | 67 | 6 |
| | **Glasgow.** | | | | |
| Foundry Coke .. .. | | — | | 47 | 0 |
| Furnace Coke .. .. | | 37 | 0 | — | |
| Gas Coke .. .. .. | | — | | | |
| | **London.** | | | | |
| Welsh or Durham Foundry, d/d London Stations in truck .. .. .. | | 45 | 0 | 53 | 0 |
| Ditto, d/d Birmingham Stations .. .. .. | | 44 | 0 | 48 | 0 |
| Yorkshire, d/d London Stations, in truck .. .. | | 42 | 6 | — | |
| Ditto, d/d Birmingham Stations .. .. .. | | 39 | 6 | | |

## CONTROL PRICES OF COKE.

| | s. | d. |
|---|---|---|
| Durham and Northumberland blast furnace .. .. | 33 | 0 |
| „ foundry .. .. .. | 38 | 0 |
| Yorkshire, Lancashire, Staffordshire, Notts., Derbyshire, Lincs, & Midland Counties blast furnace | 32 | 0 |
| South Wales blast furnace .. | 37 | 6 |
| „ foundry .. .. | 50 | 6 |

All per ton net f.o.t. ovens.

Cumberland blast furnace .. .. 37 9

d/d West Coast furnaces

## SITUATIONS VACANT AND WANTED.

TO IRONFOUNDERS and users of Steel Castings.—Crucible Steel Furnace for sale, quite simple and most economic. Advantages: (1) Low consumption of coke; (2) long life to crucible; (3) most rapid in melting; (4) little cost in starting to make steel castings; (5) tensile stress between 30 and 40 tons per sq. in.; (6) results guaranteed.—Address, Box 994, Offices of the *Foundry Trade Journal*, 165, Strand, London, W.C.2.

FOUNDRY FOREMAN WANTED by large firm in the Midlands; must be energetic, with sound practical and theoretical knowledge of Foundry Work in all its branches, both malleable and grey iron, more especially the former; repetition work; good prospects; no person already on Government work will be engaged.—Apply, with full particulars, salary required, etc., to your nearest Employment Exchange, quoting No. A. 6236.

WANTED—General Manager for Electric Steel Foundry; metallurgical knowledge not essential, but must have good commercial experience and good knowledge of general foundry practice, costs, etc.—Apply Box 124, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

A STEEL FOUNDRY in the Midlands REQUIRES an Experienced FOREMAN; a permanent position and good salary are assured for a suitable man; extensive knowledge of steel foundry work is essential.—Apply, giving full particulars, to your nearest Employment Exchange, quoting No. 2440.

EXPERIENCED FOUNDRY MANAGER Desires Position, Iron and Non-Ferrous Alloy Foundries; 28 years' practical experience at home and abroad; thorough practical and technical knowledge of all branches of foundry work in moulding machine, marine, locomotive, motor, electrical and machine tool castings; well trained in cupola practice and all kinds of alloys; age 42 years; free to accept any position offered.—Address Box 122, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

PATTERN-MAKER, to act as Foundry Foreman, Required for Foundry, 40 miles from London, doing all classes of light castings. This position will lead to Foundry Foreman solely; in the meantime a full-time foreman is not required; good encouragement and every facility given to rise with the business.—Apply, giving full particulars of age, capabilities and salary required, to your nearest Employment Exchange, mentioning the name of this Journal and No. 2260.

## FOR SALE AND WANTED.

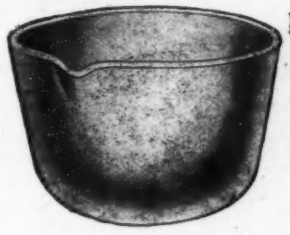
BUSINESS wanted, Iron or Non-Ferrous Foundry in Midlands. Preferably small with room for extension. Would consider active interest with option to purchase after the war.—Box No. 120, Offices of FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C 2.

ONE 7-in. (No. 1) ROOTS BLOWER, by Thwaites, Bradford; in good condition EMERGENCY CUPOLA, by Green, Keighley; complete, with fan, hood, stand; Tuyere pipes; spares for same, one fan and drop door, and 16-in. extension piece to increase capacity; output 15 cwt. per hour.—Address Box 126, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

IRONFOUNDERS.—Have your Pig and Scrap analysed by competent Metallurgist; cupola mixtures drafted out to meet the special requirements of any particular castings; good results from semi-steel mixture guaranteed. —Box No. 998, Offices FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2

NEW HYDRAULIC MOULDING PLANT, consisting of 2 moulding machines to take boxes or flask up to 20 in. by 16 in.; 1 pump and accumulator with weights' piping, &c; suitable for 5 machines, by London Emery Works Co.—Apply LONGBOTTOM & FARRAR, LTD., Keighley.


# SANKEY



Pressed Steel
**Foundry Ladles**
Plain or Lipped.

*Tell us your requirements and we will quote you.*

**JOSEPH SANKEY & SONS, Ltd.,**
Hadley Castle Works, **WELLINGTON,** Shropshire.

# GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
**FIRE CLAY.**
***Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.***
**STEEL MOULDERS' COMPOSITION, SILICA CEMENT.**

# J. GRAYSON LOWOOD & Co., Ltd.,
**DEEPCAR nr. SHEFFIELD.**
**Telegrams: "LOWOOD, DEEPCAR."**

Established 1890. Telegrams: Wm. Olsen, Hull.

CORE GUM. — **GLUTRIN.** — CORE OIL.

**PARTING. — PLUMBAGO.**

**WAX CORE VENTS.**

METALLIC CEMENT. — **RESIN.** — GANISTER.

Motto—'The Right Articles at the Right Price.'

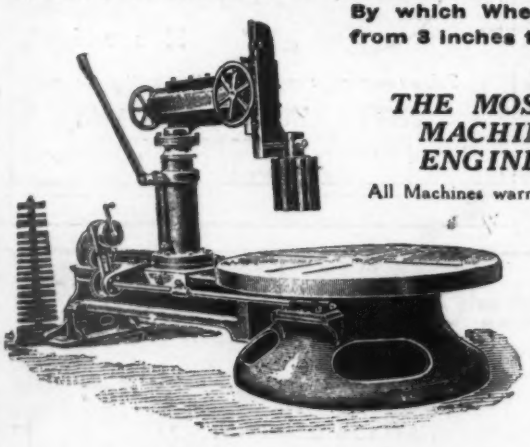
# WILLIAM OLSEN, Ltd.,

Materials and Requisites for Ironwork, Brassfounders, &c.,

**COGAN STREET, HULL.**

# WHITTAKER'S IMPROVED MOULDING MACHINE

**By which Wheels or Pulleys of any description or size from 3 inches to upwards of 20 ft. diameter can be made.**



***THE MOST COMPLETE AND EFFICIENT MACHINE HITHERTO INTRODUCED TO ENGINEERS.***

All Machines warranted to Mould with the greatest accuracy and precision.

## GEARING WHEELS

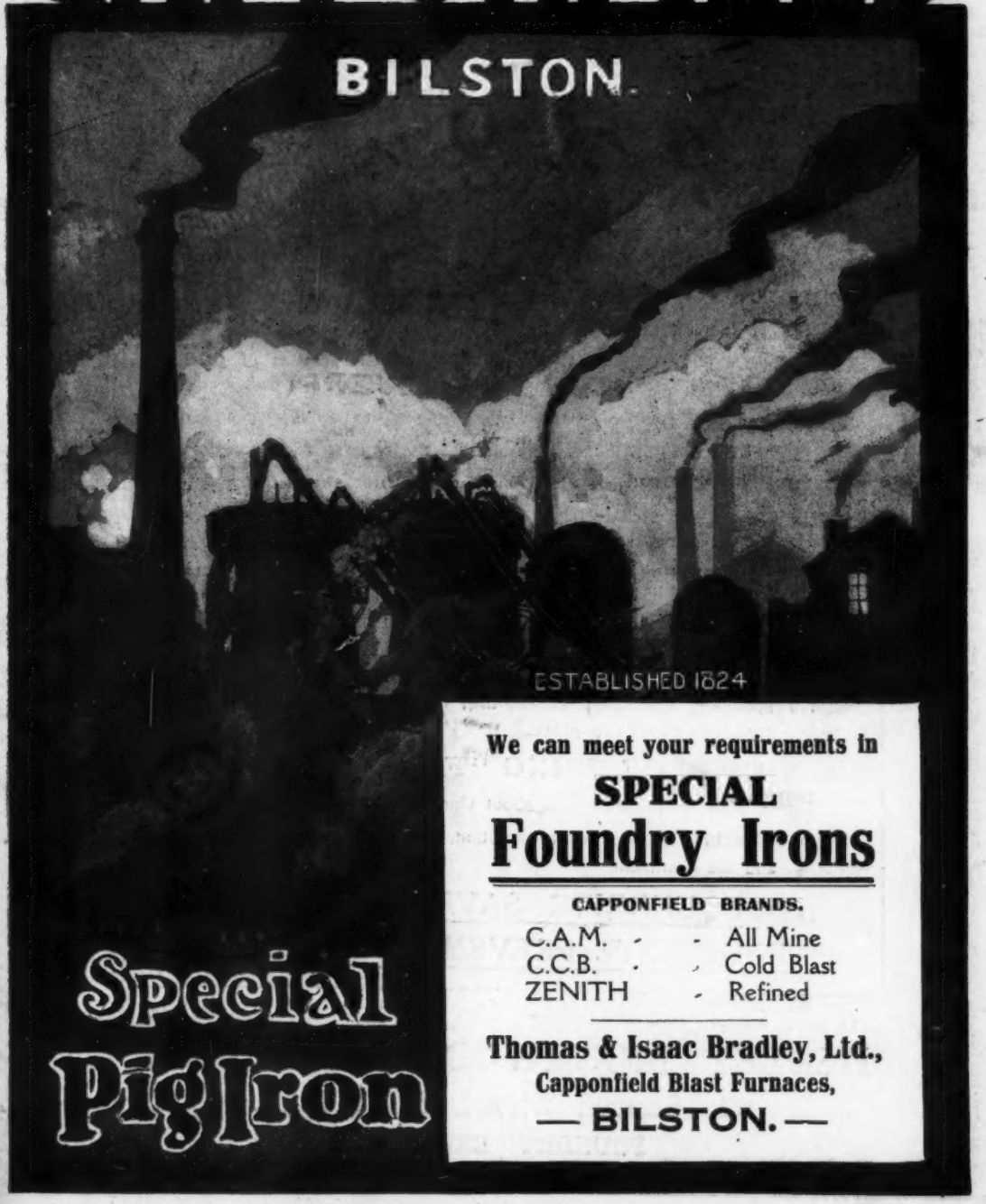
**Spur or Bevel, Straight Teeth and Double Helical Teeth Supplied to Consumers.**

## ROPE & BELT PULLEYS.

# WM. WHITTAKER & SONS, LTD.,

***SUN IRON WORKS,*** ***OLDHAM.***

# CAPPONFIELD




We can meet your requirements in

**SPECIAL**

## Foundry Irons

**CAPPONFIELD BRANDS.**

| | |
|---|---|
| C.A.M. | All Mine |
| C.C.B. | Cold Blast |
| ZENITH | Refined |

**Thomas & Isaac Bradley, Ltd.,**
**Capponfield Blast Furnaces,**
**— BILSTON. —**

# "FOUNDRITE."

**"FOUNDRYMEN have been seeking this material for years."**

**Supplied only in 40 gallon Casks. No bulk broken.**

**FOUNDRITE** is another German speciality superseded and improved.

**FOUNDRITE** is **the** binding material for moulding sand and cores.

**FOUNDRITE** SUPERSEDES and makes unnecessary all classes of **CORE GUM, LINSEED OIL and all other BINDING material.**

**FOUNDRITE** will renew old and burned sand, making it usable over and over again.

**FOUNDRITE** makes **CORES** unbreakable and the use of **core irons** unnecessary.

**FOUNDRITE** leaves **CORES** perfectly porous and does **not shrink.**

**FOUNDRITE** has been **"found right"** for all **Sand binding** in the Foundry **for all purposes.**

**FOUNDRITE** is supplied in **LIQUID** form ready for use. Dilute with Water.

**The porosity of the core is perfect, and cores so made do not shrink.**

**No blowing, cracking, crumbling, honeycombing, or loss of strength can take place.**

## COST OF USING "FOUNDRITE."

For ordinary work the price is about One Penny per gallon.

FOUNDRITE is used in all important Foundries in Great Britain and the Continent.

## FOUNDRITE SAVES MONEY.

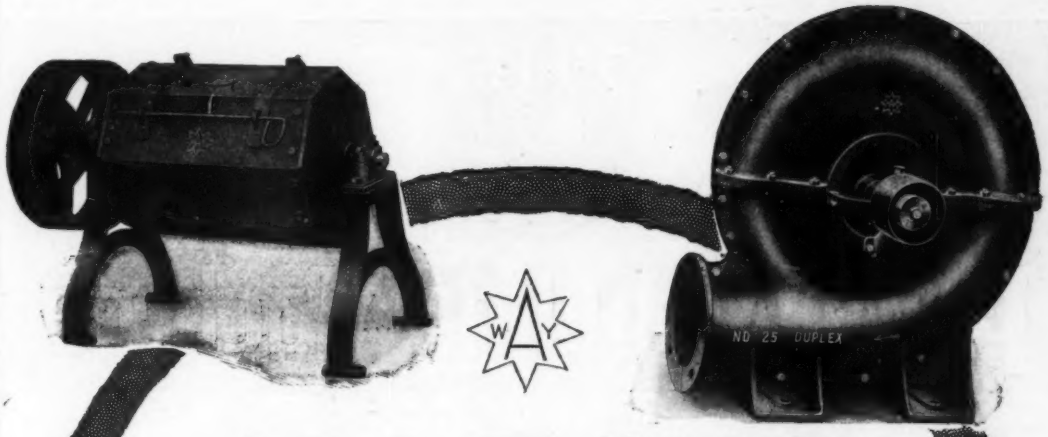
## FOUNDRITE PREVENTS WASTERS.

**Telegraphic Address—"MOROD, SHEFFIELD."** **Telephone 4318.**

## HEDLEY MOORWOOD & Co., Ltd.,

**21, Church Street, SHEFFIELD.**

**FOUNDRY EXPERTS.**




# ALLDAYS

## FOUNDRY REQUISITES

The accompanying illustrations give but a brief idea of the wide range of Foundry Equipment made by us, which includes:—

**BLOWERS, CRANES, CUPOLAS, FANS, MELTING FURNACES (oil, gas and coal fired), LADLES, SAND MIXERS, SMALL TOOLS, Etc., Etc.**

Send for Particulars— Department B.

**ALLDAYS & ONIONS Pneumatic Engineering CO., LTD.,**

**BIRMINGHAM,**

and at

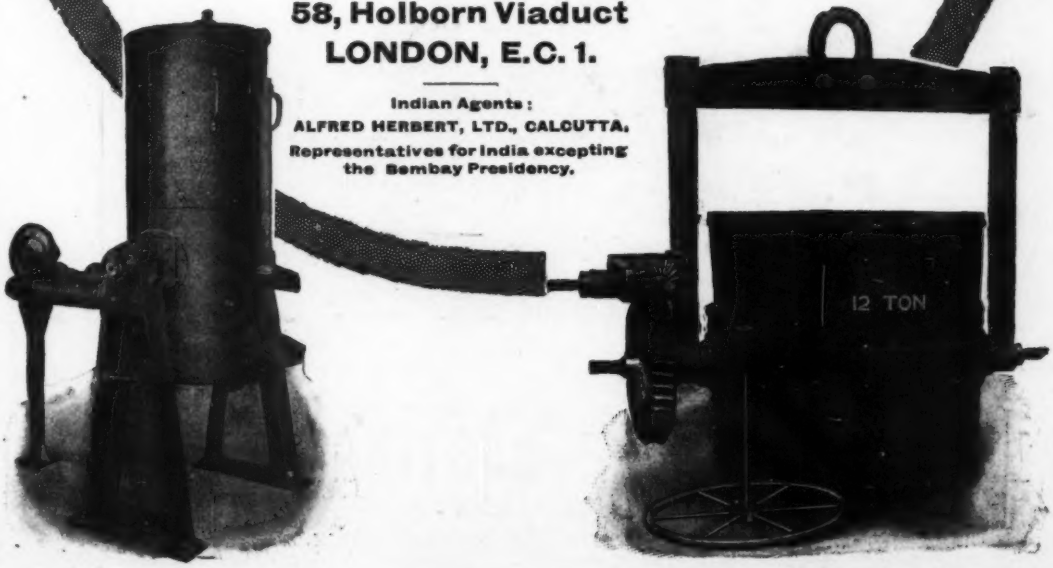
**58, Holborn Viaduct**

**LONDON, E.C. 1.**

Indian Agents:

ALFRED HERBERT, LTD., CALCUTTA.

Representatives for India excepting the Bombay Presidency.



# THE B&B Power Moulding Machine

*FULL PARTICULARS FROM*

**LEYS MALLEABLE CASTINGS CO. LTD.,**

**DERBY.**

MAKERS OF THE CELEBRATED BLACKHEART MALLEABLE CASTINGS.

**F. L. HUNT & CO..**

FOUNDRY
FURNISHERS
AND
FOUNDRY REQUISITES
Of every description.

**56, 58, 60, CHAPEL STREET, SALFORD, MANCHESTER.**

***SEND FOR BOOKLET.***

**"The Dressing of Chill-Moulds"**

**FOR STRIP, BAR & BILLET CASTING.**

*Sent free of charge to Metal Manufacturers, &c.*

**ROBERTS, GLAZEBROOK & Co., Ltd.,**
**(Dept. B) Gower St., BIRMINGHAM.**

REGENERATIVE GAS
**FURNACES**

**FOR MAKING MALLEABLE IRON AND STEEL CASTINGS.**
**CONTINUOUS ANNEALING FURNACES FOR ALL PURPOSES.**

**THE E. W. HARVEY GAS FURNACE Co. LTD**

**10, QUEEN ANNE'S GATE, WESTMINSTER, LONDON, S.W.1.**

SUCCESSORS TO FREDERICK SIEMENS' BUSINESS
FOUNDED IN LONDON BY SIR WILLIAM SIEMENS IN 1856.

**JOHN HALL & CO.**

**OF STOURBRIDGE, LIMITED.**

**STOURBRIDGE, ENGLAND.**

***Manufacturers of***

**FIRE BRICKS, BLAST FURNACE BRICKS AND CUPOLA BRICKS.**

**CUPOLA BRICKS**

**FOR LINING ORDINARY AND PATENT CUPOLA FURNACES.**

**JOHN R. FYFE & CO.,**
**SHIPLEY, Yorks.**

38¼
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL, LTD.
KINNING PARK IRONWORKS,
GLASGOW
36"
32¼"

**CAN ALSO BE MADE IN ALUMINIUM.**

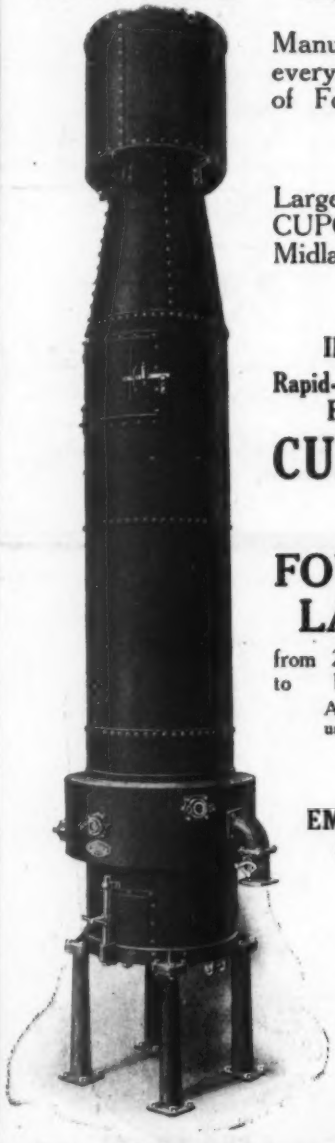
Kindly mention this paper when enquiring or ordering

*CONTRACTORS to BRITISH and ALLIED GOVERNMENTS.*

**THE CONSTRUCTIONAL ENGINEERING CO.,**

(Proprietors: STEEL WORKERS, LTD.)

Telegrams: "Structural, B'ham. Telephone: Midland 2182.



Manufacturers of every description of Foundry Plant.

Largest Makers of CUPOLAS in the Midlands.

**IMPROVED**
**Rapid-melting**
**Full-economising**
**CUPOLAS.**

**FOUNDRY LADLES**
from 28 lbs. capacity
to 10 tons ,,
A large number usually in stock.

**EMERGENCY CUPOLETTES.**

Also Makers of
Charging Platforms,
Shaking Barrels,
Hoists, Cranes,
Runways, etc.

From Photo of No. 4 Cupola complete with Tank-form Spark Arrester.
Made in all sizes from ½ ton melting capacity to 15 tons per hour.

**TITAN WORKS,**
**CHARLES HENRY STREET, BIRMINGHAM.**

**ANGLO-MEXICAN PETROLEUM CO. LTD**

16, Finsbury Circus, London, E.C.2.

Telephone: LONDON WALL 1200 (20 lines)
Telegrams: MEXPRODUX, AVE LONDON

**FIRE BRICKS & CLAY**
**CUPOLA BRICKS.**
***Best Quality.***

**LESSEES OF DELPH AND TINTERN ABBEY BLACK AND WHITE CLAY.**

**KING BROTHERS,**
**(STOURBRIDGE) Ltd.,**
**STOURBRIDGE.**

**FOUNDRY REQUISITES.**

*H. G. HILLS,*
*50, FOUNTAIN STREET (City),*
*MANCHESTER.*

# ARE YOU MAKING MANGANESE BRONZE CASTINGS?

**IF SO** you are possibly one of many Manganese Bronze Founders still adding your Manganese by means of Ferro-Manganese. There is a better way—a more scientific way. These notes should help you to find it.

**THE FERRO-MANGANESE or RISKY WAY.**

Ferro-Manganese will only melt at a temperature considerably above the melting point of Cast Iron, and in order to alloy same in the manufacture of Manganese Bronze a very high furnace temperature is necessary. Thus it invariably happens that the metal is considerably overheated, with the result that great harm is done to the Manganese Bronze and little, if any, benefit is derived from the addition of the Manganese.
Moreover, Ferro-Manganese contains large amounts of objectionable impurities which cannot be removed during its manufacture, and are therefore carried into the Manganese Bronze.

**THE MANGANESE COPPER or SCIENTIFIC WAY.**

IS TO USE MANGANESE COPPER instead of Ferro-Manganese, owing to the many advantages it possesses which make for uniformly good results in Manganese Bronze manufacture. MANGANESE COPPER melts at a lower temperature than Copper, and overheating during alloying is impossible. Furthermore, in the preparation of "Stella" Brand Manganese Copper all impurities are removed and absolute uniformity and purity is guaranteed.

In modern scientifically controlled methods it is essential that Manganese be introduced into Manganese Bronze in definite percentages—free from objectionable impurities and in such a form that it can be conveniently and economically added to the required mixture.

**Stella Brand Manganese Copper DOES THIS.**

**USE ONLY Stella Brand MANGANESE COPPER.**

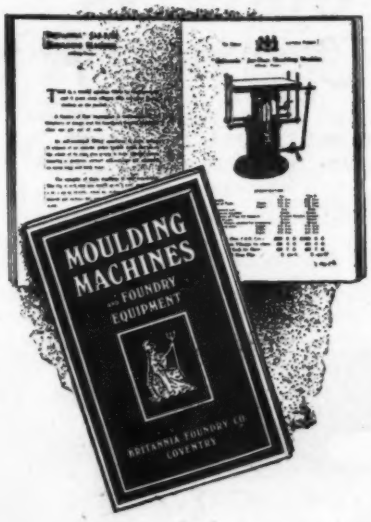
**The Laboratory Product.**

Made by exclusive use of virgin metals of highest quality.

## UNITED BRASS FOUNDERS & ENGINEERS, Ltd. MANCHESTER.

**EMPRESS FOUNDRY, CORNBROOK.**

Telegrams: "STORK, MANCHESTER."
Telephone: CENTRAL 3134 (3 lines).




JUST OFF THE PRESS.

NEW BRITANNIA CATALOGUE OF

MOULDING MACHINES,
CORE OVENS,
SAND MIXERS,
ETC.. ETC., ETC.

WRITE FOR COPY TO

## BRITANNIA FOUNDRY Co.

(A. P. SMITH, Proprietor).

COX STREET,

COVENTRY.

*Government Controlled Establishment.*

WE SUPPLY **THE** LEADING FIRMS IN THE TRADE WITH

**FOUNDRY BLACKINGS**

OF ALL KINDS

COAL DUST, CHARCOAL, PLUMBACO and BLACK-LEAD CORE GUMS and all Foundry Requisites, and have done so since 1831.

***I. & I. WALKER, EFFINGHAM MILLS, ROTHERHAM.***

Our Specialite is Studying Special Requirements.
KINDLY HAND US YOUR ENQUIRIES.

**A. J. WAKELIN, LIMITED.**

FOUNDERS

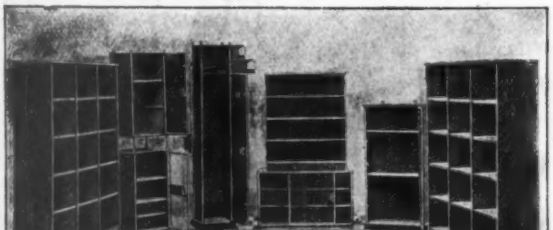
ALUMINIUM

Telephone: No. 863 Sydenham.

BRASS, GUN METAL, PHOSPHOR BRONZE, | WHITE METAL, BELL METAL.

AERO AND MAGNETO CASTINGS.

**BECKENHAM METAL WORKS, RAVENSCROFT ROAD, BECKENHAM, KENT**
(KENT HOUSE STATION).



**GIBBONS**

**Steel Shelving, Lockers, Bins, Cupboards, Etc.,**

FOR
WORKS, OFFICES, BANKS, AND WAREHOUSES.

**JAMES GIBBONS,**
St. John's Works, **WOLVERHAMPTON.**
London Office: Fisher St., Southampton Row.

R&G

**HISLOP**

Gas Fired DRYING STOVES, ANNEALING OVENS, &c.
NO SMOKE. SAVING 50 per cent.
*Adopted by the Leading Firms.*
PORTABLE MOULD DRIERS, &c.; ALSO FURNACES FOR ALL PURPOSES OF HEATING.

*GAS ENGINEERS, UNDERWOOD HOUSE, PAISLEY.*

# The HOME SECRETARY

**issued an Order, dated October 12th, 1917, requiring the provision of**

# FIRST AID OUTFITS

in all Metal Foundries.

## MAY, ROBERTS & CO., Ltd.

**can tell you exactly what is required of you under the Order and can supply you with the means of complying with it.**

**SIZE B.**

CONTENTS OF CABINETS.

### SIZE A.

**Suitable for 50 or less Workers. Polished Wood Case. Size 9 × 6½ × 6½ ins.**

1 Copy First Aid Leaflet (H.O. 923).
1 „ First Aid Instructions.
3 dozen Small Sterilized Finger Dressings.
1 dozen Medium „ Hand and Foot Dressings.
1 dozen Large „ Body Dressings.
1 Bottle No. 1 Eye Drops
3 Packets Sterilized Cotton Wool.
1 Notice Card for Factory use.

**21/- Each.**

**3 or more, 20/- each. 6 or more, 19/6 each.**

*All Dressings are Sterilized and in Cartons.*

---

**Size "A" CASES are fitted with the MINIMUM REQUIREMENTS UNDER THE ACT**

### SIZE B.

**Suitable for 150 or less workers. Polished Wood Case. Size 13 × 11 × 7 ins.**

1 Copy First Aid Leaflet, (H.O. 923).
1 „ First Aid Instructions.
3 dozen Small Finger Dressings.
3 „ Medium Hand and Foot Dressings.
1 „ Large Body Dressings.
1 „ Small Burn „
½ „ Med. „ „
½ „ Large „ „
½ „ Sterilized Eye „
1 Bottle No. 1 Eye Drops.
1 Bottle No. 2 „ „
1 Dredger Bicarbonate of Soda.
½ dozen Sterilized Cotton Wool.
1 Box Assorted Water Dressing Bandages.
2 only Triangular Bandages.
1 Box Iodine Ampoules.
1 Spool Adhesive Plaster.
1 Pair Dressing Forceps.
1 Box Safety Pins.
1 Notice Card for Factory Use.

**45/- Each.**

**3 or more, 44/- each. 6 or more, 43/6 each.**

*All Dressings are Sterilized and in Cartons.*

***Manufacturers :***

## MAY, ROBERTS & CO., Ltd.,

**7-13, Clerkenwell Road, E.C.1. And at 16, Westmoreland Street, Dublin.**

## YOU WOULDN'T BUY A CUPOLA BUILT A HUNDRED YEARS AGO — THEN WHY OPERATE YOUR CUPOLA BY METHODS THAT ARE EQUALLY OUT OF DATE?

YOU may not have thought about it—but there IS something NEW in cupola practice as well as other things—and we have taught it to more than 2,900 foundrymen in all parts of the world.

COKE SAVINGS are merely incidental to good melting and McLain's Semi-Steel. Many foundrymen still believe more coke is necessary to melt steel scrap—while others think steel cannot be melted in cupolas—but we have a surprise for both.

McLAIN'S SEMI-STEEL is the CONNECTING LINK between iron and steel—is better than gray iron at every point—25 to 60% stronger and surpasses steel for wearing qualities. It combines the good qualities of both. NO BLOW HOLES—SPONGINESS OR OTHER DEFECTS. It is a clean, close grained metal, that machines easily, polishes like silver, but COSTS LESS THAN GRAY IRON.

Our advice is applicable to all shops—no lengthy course of study—all concisely arranged to meet the demands of the busy foundryman—all practical—no theories to be tried out. Our advice may be applied to your requirements at once.

Send us your order now with the name of YOUR BANK and we will forward you McLain's System complete with SIGHT DRAFT attached. You will receive a report on your cupola practice also. The price of McLain's System complete is $75—you don't pay for it until your bank receives it and notifies you.

***Full information free—to save time send us your order.***

**NO EXPERIMENTS. NO SPECIAL EQUIPMENT. NO PATENT TUYERES OR FLUXES REQUIRED. JUST COMMON SENSE IDEAS.**

# McLAIN'S SYSTEM, INC.

**710 GOLDSMITH BLDG. MILWAUKEE, WIS., U.S.A.**

# T. & I. BRADLEY & SONS, LTD.,

**DARLASTON, South Staffs.**

## SPECIAL COLD BLAST PIG IRONS.

**Brands:**

| R.A.M. | IXL. C.B.R. | D.M.R. |
|---|---|---|
| FOR CYLINDERS. | FOR CHILLED CASTINGS, &c. | CHARCOAL FOR MALLEABLE CASTINGS, &c. |

• SELECTION • ANALYSIS • FRACTURE AND CHILL • GUARANTEED •

| ALL MINE. | WARM BLAST. | COLD BLAST. |
|---|---|---|
| ◆ A M ◆ | I X L. | I X L.-CB. |

☛ IF YOU HAVE DIFFICULTIES WITH YOUR SPECIAL CASTINGS CONSULT US.
We can put you right.

## A SCRAP OF PAPER STARTED THIS AND SCRAP WILL FINISH IT!

WE BUY SCRAP OF ALL DESCRIPTIONS TO ASSIST THE OUTPUT OF ALL

**MUNITIONS OF WAR**

Branches—GATESHEAD, BIRMINGHAM, WOOLWICH, LLANELLY, LISKEARD and GLASGOW.

Telegrams—"FERRIC, SHEFFIELD."
Tel.—1242, 1241, 3072; Trunk 1013.

## MARPLE & GILLOTT LTD., SHEFFIELD.

# FOUNDRY PLANT.

***"Rapid" Cupolas,***

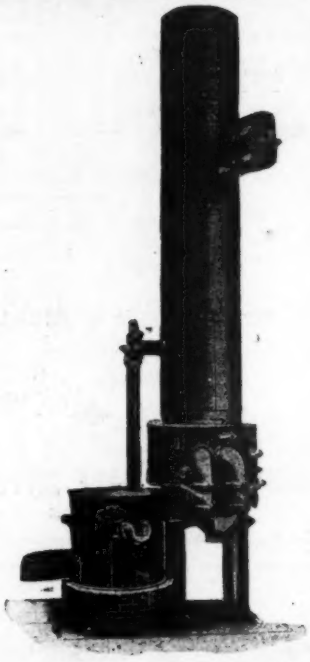
with or without receivers or drop bottoms.

***Roots' Blowers,***

belt, steam-engine, or electro-motor driven.

***Charging Platforms,***

***Hoists, and Ladles.***



**ECONOMICAL RESULTS GUARANTEED.**

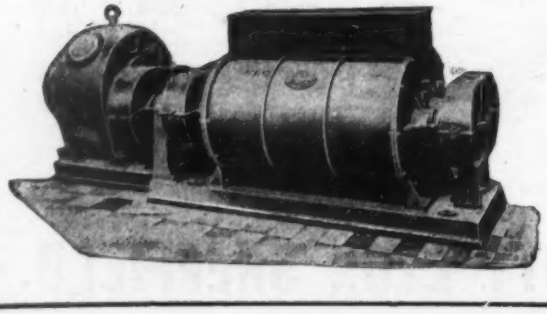
We are also Manufacturers of Steam Hammers, Smiths' Hearths, Centrifugal Pumps and Fans, High-Speed Engines and the "Bradford" Patent Boiler Feed Pump.

We are the original makers of "Rapid" Cupolas as under Stewart's Patent. We make this intimation as other makers are introducing this description, which had become established as a synonym of Stewart's Cupolas.

**CONTRACTORS TO HIS MAJESTY'S GOVERNMENT.**

# THWAITES BROS., LTD.,

***Vulcan Ironworks, BRADFORD.***



Telegrams—
"THWAITES, BRADFORD."

Telephone—
Nos. 3459 and 3460 BRADFORD.

**London Office:**
**96 & 98, Leadenhall Street, E.C.**

**Catalogues on Application.**

# A NEW STEEL BARROW

(PATENTED).

"BRABY'S BALANCED BARROW."

The Handiest and Cheapest Barrow in the market. Specially designed for coal, dross, ashes, etc. Its capacity is 25 per cent. greater than the ordinary style, yet it can be wheeled with half the labour, and can be emptied much more quickly. It is a perfectly balanced barrow, and a full load can be easily wheeled by a boy.

NOTE.—This Barrow can be taken right up to mouth of furnace and the ashes drawn into the barrow direct from the furnace.

The "B.B.B."

**BRABY** for high grade **STEEL**
SHEETS and PLATES up to 15 FEET LONG.
RANGE OF GAUGES 8 to 30 W.G.
RANGE OF WIDTHS 12 to 60 in.

**BRABY** for improved wrought **STEEL**
BARROWS, BOGIES, TRUCKS, GUTTERS, PIPES, &c.

**BRABY** for iron and **STEEL**
ROOFS and BUILDINGS.

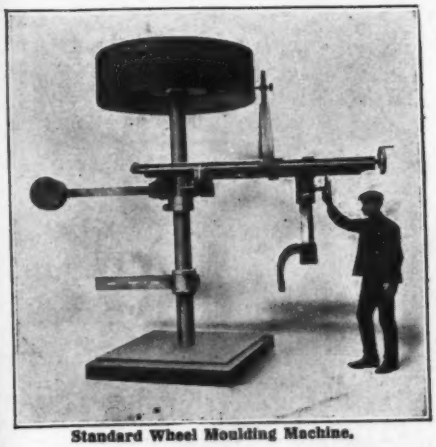
**BRABY** for unbreakable **STEEL**
SASHES, CASEMENTS, and PUTTYLESS ROOFLIGHTS.

**BRABY** for galvanised corrugated **STEEL**
SHEETS: "EMPRESS" and "SUN" BRANDS.

**FREDERICK BRABY & Co., Ltd.,** Eclipse Iron and Galvanising Works and Steel Sheet Rolling Mills, Petershill Road, GLASGOW.

Show Rooms and Aluminium Warehouse, 124, St. Vincent Street, Glasgow.
Rustless Iron, Galvanising and Copper Works, FALKIRK.

Also at London, Deptford, Liverpool, Bristol, Belfast, and Dublin. CONTRACTORS to BRITISH and FOREIGN GOVERNMENTS. Telegrams—"Braby, Glasgow."



Standard Wheel Moulding Machine.

## ALL IRON AND STEEL FOUNDRIES

SHOULD BE EQUIPPED WITH

# STEWART WHEEL MOULDING MACHINES.

**Complete Satisfaction Guaranteed**

Wheels Moulded by this Machine.

**No Loose Parts Liable to be Lost.**

**ACCURATE. PORTABLE. CHEAP.**

*WRITE FOR PRICE AND PARTICULARS TO*

## DUNCAN STEWART & CO., LTD.,

LONDON ROAD IRONWORKS, GLASGOW.

**VERZOCCHI & DE ROMANO**

**MILAN (Italy).**

Importers of

**MINERALS. METALS. ALLOYS.**

also

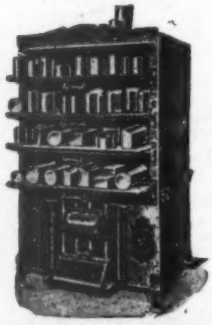
***REFRACTORY MATERIALS and all requisites for the Engineering Trades.***

Correspondence Invited.

**T. E. MANSERGH.**

EVERY DESCRIPTION OF
**MOULDERS'**
PATENT WOOD, MINERAL AND
**COAL DUST BLACKINGS**
MANUFACTURED.

Wheathill Charcoal Works, **SALFORD.**



***THE "PORTWAY"***

**PORTABLE CORE OVENS**

***For Gas or Fuel.***

**TESTIMONIAL.**

From The Braintree Castings Co.,
Chapel Hill Foundries, Braintree, Essex.

Gentlemen,

We are very pleased with the Core Oven we recently purchased from you. We find it dries the cores quickly without burning them. It is very handy and economical to use and is altogether superior to other ovens of this type we have in use.

Will you please quote us your best price for four more like it,

Yours faithfully,
For The Braintree Castings Co.,
(Signed) W. B. LAKE, Director.

Makers: **C. PORTWAY & SON,** TORTOISE STOVE & PORTWAY PORTABLE OVEN WORKS, **HALSTEAD, ESSEX.**

**WILLIAM CUMMING & CO., LTD.,**

**IRONFOUNDERS FURNISHERS**

Established 1840.

FOR
IRONFOUNDERS'
BLACKING
PLUMBAGO
BLACK LEAD
CORE GUM
COAL DUST
ETC.

*Write for Quotations.*

WORKS—
Kelvinvale Mills, Maryhill, Glasgow.
Sunnyside Blacking Mills, Falkirk.
Old Packet Wharf, Middlesbrough.
Albion, West Bromwich.
Whittington Bracking Mills, Nr. Chesterfield.

Also
THE WELL-KNOWN BRANDS
"IMPERIAL"
"EUREKA"
"VULCAN"
"CROWN"

Registered Brand—
"SHALACO"

Telegraphic Address—
Prudence, Glasgow.
Cummin, Blacking Mills, Camelon.
Cumming, Whittington, Chesterfield.

# THOS. BROADBENT & SONS, Ltd.

## CENTRAL IRONWORKS, HUDDERSFIELD.

TRY A

# BROADBENT CRANE

IN YOUR FOUNDRY

AND SAVE

## TIME, LABOUR AND EXPENSE.

Tels: Broadbent, Huddersfield.
Tele: 1581 (4 lines).

London Office, Suffolk House,
Laurence Pountney Hill, E.C.

# ANALYSES

MECHANICAL TESTS
and MICROGRAPHS

Consulting Metallurgists and Analytical Chemists.

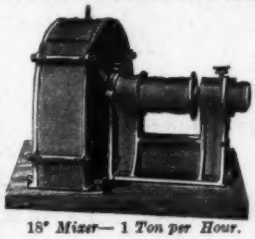
— SPECIALISTS —
IN FOUNDRY WORK.

Laboratory for all kinds of Metallurgical Investigations.

**NAISH & CROFT,**

150, Alma Street, BIRMINGHAM. | 34, University Mansions Putney, LONDON, S.W

## THE INVINCIBLE SAND MIXER.



18" *Mixer*— 1 *Ton per Hour.*

Fitted with Patent Roller Bearings, Renewable Reels, Grinds, Mixes, Screens & Prepares.

OLD AND NEW FOUNDRY SANDS AT LOWEST COST.

**Saves Labour—Reduces Foundry Costs.**

Made in Three Sizes—1, 3 and 6 Tons per hour capacity.

USED IN PRINCIPAL FOUNDRIES.

PRICES ON APPLICATION.

**C. E. V. HALL, 26, Paradise Sq., Sheffield.**

# "GLUTRIN."

We are Agents for the above, the strongest and cheapest sand binder made.

Glutrin contains no acid, and in consequence will not injure your coremakers' hands, nor your core boxes, nor your ovens.

It can be used to advantage with the water in Black Wash.

Glutrin can be put to a greater variety of uses than any other adhesive used in the foundry, thus simplifying stock carrying.

We are prepared to give prompt delivery of any quantity from one barrel up.

## THOMAS WILKINSON & CO., LTD.,

*Manufacturers and Merchants,* **MIDDLESBROUGH.**

COMPLETE

# Foundry Equipment.

Telegrams: "LADLES" MANCHESTER.

Telephone: "N° 2297 CENTRAL" MANCHESTER.

JAMES EVANS & Co. BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.